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(54) Title: SMALL GEOMETRY PADS AND SYSTEM FOR WIRELESS POWER SUPPLY

(57) Abstract: An apparatus comprising a mobile electronic device having two electrical contact zones, the mobile device to be placed on a pad having two contact zones corresponding to the two contact zones of the telephone, the pad receiving electrical power from a power supply, when the two contact zone of the telephone are placed in contact with the two contact zones of the pad an electrical circuit is established.

Small Geometry Pads and System for Wireless Power Supply

This application claims priority to provisional application no. 60/419,441 filed 10/18/2002 titled "Small Geometry Pads and System For Wireless Power Supply" (attorney docket no. 6041.P010z) and to provisional application no. 60/421,216 filed 10/24/2002 titled "Non Homogenous Zones In A Free Positioning Power Transfer" (attorney docket no. 6041.P011z). Both provisional applications are herein incorporated by reference.

Background

Although the system described in previous co-pending provisional application titled "Enhanced Contact Systems For Surfaces And Devices" filed 09/25/2002, Attorney Docket No. 6041.P009z, application no. 60/413,791, which is incorporated by reference, of which this disclosure is related, is very useful, sometimes only certain aspects of its novel art are required in a low-end, limited-usage application. In particular, for very inexpensive, low-end devices, it may be wasteful to integrate a full system into the basic product.

What is clearly needed in such cases is a simplified, basic pad that allows the user to start with a low-cost minimum solution, but also allows system upgrades at a later time.

In addition, in some cases, devices may vary wildly, both in size and in electrical requirements. For example, a cell phone may have substantially different geometry from a notebook computer, and a PDA may differ likewise from both of these previous devices. Therefore, the geometry of a contact pad that is suitable for a cell phone or a PDA may not be suitable for a notebook, and vice versa.

In particular, a small cell phone may require densely spaced contact zones (i.e. an area with possibly a multitude of contact points, but all electrically connected together and controlled by a "single contact" node as described earlier), with a correspondingly great number of contacts. Thus, for a notebook-sized pad such dense contact spacing becomes uneconomical, due to the large total number of contact zones (potentially several hundred). For example, if a grid on a pad for a cell phone requires a one-inch center-to-center between distinct contact zones (one contact area may contain several

contact points), then a desktop pad of 20 x 40 inches would require 800 contact zones, which would be prohibitively expensive. What is clearly needed is a multi-zone approach that has different contact-area densities in different zones, and the different zones may be indicated by accordingly different colors.

Furthermore, in some cases, upgrade ability by attaching a contact interface to a docking port in lieu of a power input port or a connector that was designed to allow attaching of the adapter to the device, or any other suitable connector able to insert power into a device.

Brief Description of Drawings

Figure 1 shows a mobile electronic device, such as a mobile telephone;

Figure 2 shows the phone on pad;

Figure 3 shows another embodiment;

Figure 4 illustrates a phone 310 set down onto pad;

Figure 5 shows a pad with multiple zones;

Figure 6 shows different cell phone positions on a pad; and

Figure 7 shows such an approach wherein the first matrix array switch takes voltages from a power supplier lines.

Description of the Embodiment

Figure 1 shows a mobile electronic device, such as a mobile telephone 110. It has two contact zones 111a and 111b, as described in the previous co-pending applications. Instead of a full pad with many zones, in this case the system has only a small pad 100 with only two contact zones, 121a and 121b. Power supply 123 may be a very basic power supply, or even the standard power supply of current art that is sold with the device 110. It may have only limited capabilities or even only capabilities to operate that one single device. In some cases, such a small pad can be integrated in a larger equipment such as car dashboard, furniture, treadmills, etc.

The user simply puts the phone 110 down onto pad 100, thus establishing an electrical circuit.

Figure 2 shows the phone 110 on pad 100. It is clearly visible that phone contacts

111a and 111b are aligned with pad contacts 121a and 121b. The angle omega 222 between device main axis and the pad main axis does not have to be exactly zero degrees. Omega 222 may be 10 degrees, 20 degrees, or even as great as 45 degrees. In some cases, it can also be rotated by 180 degrees in addition to the slight angles mentioned above.

In some cases, pad 100 may be bounded by a small frame (not shown) to limit the range of omega 222. That frame may have an opening to accommodate protruding features that are characteristics of the device, such as the antenna, so that placing the device in the frame with the protruding features in the corresponding opening would also restrict the omega 222, without, at the same time, requiring precise insertion, as would typically be required when a device such as phone 110 is inserted into a charging cradle (not shown) of the type used in current art.

Figure 3 shows another embodiment of the novel art of this disclosure. Phone 310 may have two or three contacts 311a, 311b, and, optionally, 311b. Circular pad 300 has a center contact zone 321a, an outer contact ring 321b, and a no-contact zone 321c, which lies between zones 321a and 321b. Pad 300 is connected by wire 322 to power supply 323 (may be the same as power supply 123), which in turn plugs in to main ac power source 324.

As shown in **Figure 4**, in most cases, the phone 310 may be casually set down onto pad 300. Due to the circular nature this embodiment, there is no limit to the omega 422 of alignment of the phone with the pad. Pad 300 may in some cases have a raised edge at its outer perimeter to force the phone into correct contact with the pad; however, there may be a gap of a few millimeters (a quarter-inch to a half-inch) allowing convenient, sloppy application, rather than requiring precise positioning, as is generally required with insertion of a device into a power connector or cradle in current art.

In some cases, due to the small nature of these pads, a plastic clip-on or slip-on cover (not shown) may be used that has openings for the contact pads, allowing the user to customize the look and possibly the feel of the pad. Options could include different colors, flags, transparency, rubbery or fuzzy coatings, etc.

In some cases even additional lighting effects (not shown) may be offered, such as blue pulsing during charge, low-level blue when trickle charging, red flashing when mis-connected, etc. Alternatively, the light color could change to indicate the level of charge, much as some a fuel gauges indicate the fuel level, starting with red or orange

("empty") and thence progressing to yellow, green and finally blue (everything is "cool"). In some cases the lighting effects and other functions may be added by the user as a plug-in option into an existing, basic passive pad.

Further, many modifications and/or additions may be made without departing from the spirit of the invention. For example, in many cases, typically, a power supply may have a current limit or other protection mechanism, so the pad may be completely passive, to satisfy safety requirements.

Further, in some cases, because a device may have a dc/dc regulator able to accept a wide range of voltages, no issues would occur if there were no exact match. In yet other cases, devices may have a protection mechanism that would pass the power to the device only when the voltage and current are in range, as described earlier in previous applications. In yet other cases, a device may include an automatic polarity routing (e.g., active or passive rectifier bridge). The attached appendices A, B, C, D, E, F, G, H, and I are incorporated herein by reference.

Non Homogenous Zones In A Free Positioning Power Transfer

Figure 5 shows pad 500, with zones 510 and 511. Zone 510 could be for small devices and could be indicated by, for example, yellow coloring; whereas zone 511 could have a more generic color and be intended for larger devices such as, for example, a notebook computer. The contact density of zones 510 and 511 may differ markedly, so that the two zones may contain, for example, the same number of contacts, even though their sizes are substantially different.

In some cases, although the zones may have different electrical and mechanical properties, they can be made similar, such that for the user they look as a consistent surface with only (optional) artificial markings to distinguish between the zones. Further, in some cases zones may overlap or include other zones. For example, the entire surface may be a Notebook zone (i.e. can provide 12-20V and guaranteed to work with large contact spacing) while the right hand portion is also a PDA zone (2-6V and guaranteed to work also with smaller device spacing). In these cases, the PDA zone is included in the notebook zone and therefore a notebook can work on the entire surface.

Figure 6 shows different cell phone positions on pad 600. Cell phone position 601 straddles zones 610 and 611. Thus, if the sensing mechanism cannot recognize the cross zone positioning of the phone and deal with the differing contact densities of the two zones, it may not be able to turn on power, even though it would be technically possible.

Position 602 would be the proper placement location for the cell phone, and thus the power would be turned on. Position 603 would not allow, in many cases the cell phone to be recognized, because, due to the bigger contact area sizes, both cell phone contacts would only touch one pad area. Similarly, a notebook crossing both zones may not be turned on, even though it might be possible to do so.

The size and arrangement of zones 610 and 611 is purely arbitrary. For example, the smaller zone may be a strip along the right edge of the pad, or it may be a border around all the edges, or a strip along the left and the right edges allowing the notebook to be centered and smaller devices placed on either side of the notebook. In other cases, the smaller zone may be at the front or at the back edge of the pad, or it may just be a circle (in the nature of a "hot spot") within the pad.

In some cases, a straddling device in a position such as position 201, if recognized properly, may still be operated, even though not completely within one zone. **Figure 7** shows such an approach wherein the first matrix array switch 709 takes voltages from a power supplier lines 700 (coming from power supply, not shown here, but discussed in previous section) and in conjunction with a controller (not shown) via line 702 delivers power on sensing to zone A 310 (i.e., zone 711 of pad 700) and has return lines into the current-sensing circuitry 705 and the ground return line 703.

Off one contact node, a second switch matrix 720 is located. Matrix 720 is also controlled by a controller (not shown) via line 722 and may also have an intermediate additional regulator 724, which in some cases may be programmable by said controller. This second matrix 720 then controls zone B 730, which in the earlier example may be the small area 710 on pad 700. Switch matrix 720 may connect to current sensing circuitry 705 directly, and sense line in supply relay loop 700 through matrix 709.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novel art of this

disclosure. For example, power regulator 724 may connect directly to one of the supply areas 700 rather than via primary switching area 709.

In another aspect of the invention, an after market add-on may be offered, that is glued or otherwise mechanically connected to a device, and may offer in some cases multiple geometries, as to allow cross zone operation, i.e. for notebooks (not shown here). In some cases, it may rather connect to a different port than the regular power port, such as a docking port, USB on the go port, or other types of ports facilitating insertion of electrical power into a device (not shown here).

In yet another example, the surface is forcefully separated into zones. That means, even if a smaller device is placed on the large contact zone such that its contacts happen to touch two base contacts, it is intentionally not provided power, in order to it to make the behavior more consistent to the user (so the PDA will work only in the zone designated for PDA's).

Further, the attached adapter may have flexibility built in the adapter body (that is, contacts connected tightly to a flexible base or adapter body) to match the mechanical requirements of each zone.

As is discussed, the device parameters may include information such as device type and category information regarding the device contact geometry, size, spacing, and shape that will be used to enable/disable powering the device on the various zones. In some cases a device compatibility check that does not deliver power to the device if it is not compatible with the surface even if in some condition it may get power from that device. For example, when a small device placed on a surface with large contacts, in some location it may touch two contacts properly in others it will not. In this case, the system will not deliver power at all for consistency. The device geometry parameters may be received for example from the ID chip. Same concept if the surface has designated area for small devices, they will not work on the rest of the surface even if they happen to touch the contacts properly. The attached appendix J is incorporated herein by reference.

Appendix A

Application for Provisional Patent

CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM

Inventors: Ofer Goren, Tal Dayan, and Elliott Stein

CROSS-REFERENCES TO RELATED APPLICATIONS: TBD

BACKGROUND & FIELD OF INVENTION:

Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

What is clearly needed is a better way to solve these problems by providing a power source that allows random placement and movement of the device without requiring plugging in a cable, cradle etc..

The field of the invention is that of power supplies and re-chargers interconnections for portable or mobile devices.

DESCRIPTION OF THE INVENTION:

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other as the "Adapter" but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the 'relative placement' or "Placement" in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS t The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

1. Contact A1 of the Base touches contact B1 of the Adapter;
2. Contact A2 of the Base touch contact B2 of the Adapter;
3. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

CLAIMS:

1. A system for improving the connection between a mobile device and a power charger unit, consisting of a two substantially planar surfaces, each of those surfaces containing at least two contacts, wherein for closing the electric circuit all that is required is to set on surface in contact with the other without accurate alignment.

2. A method for improving the connection between a mobile device and a power charger unit, consisting of a two substantially planar surfaces, each of those surfaces containing at least two contacts, wherein for closing the electric circuit all that is required is i) to set on surface in contact with the other without accurate alignment.

Appendix B

Application for Provisional Patent

AUTOMATIC AND ADAPTIVE POWER SUPPLY

Inventors: Ofer Goren, Tal Dayan, and Elliott Stein

CROSS-REFERENCES TO RELATED APPLICATIONS: Application No. 10/____ filed 03/01/2002 titled COUPLER WITH THREE DEGREES OF FREEDOM.

BACKGROUND FIELD OF INVENTION:

Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system.

What is clearly needed is a power supply control unit that controls the electrical power provided to contacts of a power supply system or a coupling system respectively.

The field of the invention is that of power supplies and re-chargers for portable and mobile devices.

Description of the preferred embodiment

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters

such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 1 shows a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 2 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple

mechanical or relay type switches, as indicated her for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts.

Fig. 3 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

CLAIMS:

1. A power provisioning system, having a power supply with two or more electrical contacts, further including in the power supply a sensing unit connected within the power supply and a control unit, also connected within the power supply, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the power supply, such that, when the of contacts of the load touch contacts of the power supply, the sensing unit senses that touching and instructs the control unit to provide power to some of the contacts of the Power Supply.

2. A method for power provisioning, having a power supply with two or more electrical contacts, further including in the power supply a sensing unit connected within the power supply and a control unit, also connected within the power supply, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the power supply, wherein, upon the of contacts of the load touch contacts of the power supply, i) the sensing unit senses that touching and ii) instructs the control unit to provide power to some of the contacts of the Power Supply.

Appendix C

Application for Provisional Patent

WIRELESS ADAPTIVE POWER PRVISIONING SYSTEM FOR SMALL DEVICES

Inventors Tal Dayan
Ofer Goren
Dan Kikinis

CROSS-REFERENCES TO RELATED APPLICATIONS:

COUPLER WITH THREE DEGREES OF FREEDOM
AN AUTOMATIC AND ADAPTIVE POWER SUPPLY

BACKGROUND FIELD OF INVENTION: Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices. Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system and application titled "AN AUTOMATIC AND ADAPTIVE POWER SUPPLY" describing a multi contact smart power supply.

What is clearly needed, is a better way to allow portable devices to be charged, without requiring plugging in a cable, cradle etc.. that would inhibit their use to some degree while charging.

The field of the invention is that of power supplies and re-chargers for portable and mobile devices.

Description of the preferred embodiment

Connecting

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation

is the above mentioned coordinate system, and wires marked “wires (adapter side)” and “wires (base side)” respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the “Base” and to the other as the “Adapter” but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the ‘relative placement’ or “Placement” in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as

projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS. The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

4. Contact A1 of the Base touches contact B1 of the Adapter;
5. Contact A2 of the Base touch contact B2 of the Adapter;
6. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the

proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. (only array shown) Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Powering

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 5 shows a simplified diagrammatical overview of such a system. The

power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 6 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple mechanical or relay type switches, as indicated here for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of

the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination or any passive or active circuit, even inductors and capacitors can be used to convey presence and parameters to the base. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load or, in some cases, the adapter can have intelligence to disconnect the load until it establish a connection or gets power from the base, this may be useful for example for resistive loads.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts. In some cases, the power base may disconnect on sense of the device current usage pattern.

Fig. 7 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device. It is clear to person skilled in the art, that rather than having a number of fixed voltage rails, for example two programmable rails may be used, and the parameters reported back from the ID device may help select the voltages.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

System

Combining the above-described elements into a complete system allows the user to have more freedom when using a notebook computer, for example, at a desk or similar prepared type of environment, such as a home office, a hotelling situation in a corporate environment, or even at a kiosk in an airport or other public place.

Figure 8 shows a desk 801 on which a desk mat 800 is placed. The desk mat is built according to the descriptions mentioned above. In the future, in some cases such a desk mat may be integrated into a part of the desk surface, rather than being a separate mat, but for the near future it will be easier to replace regular desk mats with these conductive types of desk mats.

Further, by using different techniques, the appearance may be changed dramatically. For example, a conductive plastic may be applied in a thin layer on top of a metallic conductor interleaved with non conductive material surrounding both the conductive plastic and metal. In other cases, metallic areas may be silk-screened with color, leaving sufficient openings for contact. In yet other cases, acidic etching into the metal may create openings to deposit colored resin, similar to anodizing of aluminum. In yet other cases, chrome-plated or nickel finished round metal spots may be embedded in a black rubber mat, for creative design. All these approaches can be used

to make a desk mat product to be visually appealing to consumers, but essentially do not diverge from the invention disclosed here.

Cabling system 803 is hidden away behind the desk through an opening and connects to a power supply unit 802 that contains both the power source itself and the sensing and switching capability as described above. Power cord 804 with power connector 805 plugs into a regular household ac outlet, of the type available in normal homes and offices.

Figure 9 shows one case, in which the Adaptor Piece as attached to a notebook 900. The notebook is shown from the lower rear, with a view of notebook base 902 and notebook lid 901, which is slightly open. Adaptor piece 910 is attached to the bottom of the notebook using, for example, hook-and-pile fastener or mounting tape, or any other suitable fastening method, including but not limited to screws, bolts, glue, cement, snaps etc.. Adaptor piece 910 has, in this example, three separate areas 911, 912, and 913, wherein areas 911 and 913 may be conductive surfaces and area 912 is an insulator. Cable 920 plugs into the regular power supply of the notebook. Also shown is a wireless Ethernet card 930 protruding from the PCMCIA slot, a typical situation with notebook computers. In some cases, the adaptor may be an integral part of the notebook's enclosure, or in some cases more specifically also integrated with the battery or its enclosure, hence not requiring a special cable, or an attachment. Also, in case of a cable mentioned above, a convenience receptacle may be offered, so the user does not have to unplug the adapter piece in case of using a regular charger w/base. In some of these cases, the adapter may be electrically disconnected, as to avoid hazards by exposing hot contacts.

Figure 10 shows an overview of the notebook 900 placed freely on the desk 801 of Figure 8, as an example of a system setup. Notebook 900 is depicted as placed at an odd angle, to exemplify that such a device may, according to the novel art of this disclosure, be placed in any kind of position in this example on mat 800, allowing for the system to charge while the notebook is in use, without having to plug in any cables or carry any power supplies.

Many variations may be made to the system as presented herein without departing from the spirit of the novel art of this disclosure.

Contacts 911,912 & 913 of adaptor piece 910 may be round rather that square; its dimensions may match those of the notebook base, rather than being scaled to a functional minimal size, following the rules proposed earlier; adaptor piece 910 may connect to a docking connector available on the bottom of some notebooks, rather than to the power cord. Or, in a preferred mode, adaptor piece 910 may be integrated into the standard enclosure of a notebook, eliminating the need for a separate, add-on device.

Desk mat 800 may also have many variations. It may be used in conjunction with a standard power supply provided by the notebook manufacturer and contain by itself only the sensing and switching functionality, rather than the full power supply.

In yet other cases, the system may also be used to transmit data over the established electrical connections, rather than just power. That may be achieved by either using additional contacts, as is proposed earlier, or by modulating the signal(s) onto the existing power leads, and adding a filter (i.e. inductor/cap) to separate the dc supply and the high speed data signals, such as Ethernet etc. In such cases, an Ethernet port may be offered on both the desk mat 800 (not shown) and a cable on adapter piece 910 (not shown). Other network standards besides Ethernet may also be supported, as desired or required by the market, both current and future ones. In some cases yet, wireless methods may be used for the data, such as optical including InfraRed (IR), inductive coupling, capacitive coupling, or radio frequency with or without some modulation techniques. That may include virtual docking connections or regular Local Area Network connections or both.

Many variations may be formed by shifting the partitioning or integration of features among various elements. In some cases, for example, the mat may be integrated into the desk; in other cases, it may be a foldable or rollable mat, reduced in size for easy portability, for the convenience of travelers. Further, in some cases input devices may be integrated in the base (e.g. a tablet or a large touch pad), the pad surface may be extra mouse friendly (both for mechanical and optical mice), or it may also be used to powering semi-mobile devices such as desk lamp or electric stapler etc. Additionally, there are advantages to ensure that the pad is an anti static pad (making it even safer than using no pad at all), or some of these extensions may be offered as

modules, including making the pad area modular (cut to order, tiles, etc). In some cases, the base provides a standard power and each device/adapter converts it to the level needed by its respective device. Also, in some cases some information and sensing is done in the reversed direction (base to device) and the device also makes some decisions or power switching (e.g. is that base safe for me).

Many other configurations and variations are also possible that do not depart from the spirit of the invention.

Sample CLAIM:

Claim 1: A mobile device power delivery system, having a power supply with two or more electrical contacts, further a sensing unit connected to the power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, such that, when the of contacts of the load touch contacts of the base unit, the sensing unit senses that touching and instructs the control unit to provide power to some of the contacts of the base unit.

Claim 2: A method for power delivery to a mobile device, having a power supply with two or more electrical contacts, further a sensing unit connected to the power supply and a control unit, also connected to the power supply, and also connected to a

base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, wherein, i) upon touching of contacts of the load to contacts of the base unit, ii) the sensing unit senses that touching and instructs the control unit to provide power to some of the contacts of the base unit.

Appendix D

Application for Provisional Patent

TITLE:

ENHANCED WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

Inventors Tal Dayan
Andy Goren
Dan Kikinis
Bill Maggs

CROSS-REFERENCES TO RELATED APPLICATIONS:

COUPLER WITH THREE DEGREES OF FREEDOM

AN AUTOMATIC AND ADAPTIVE POWER SUPPLY

WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

BACKGROUND **FIELD OF INVENTION:** Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers,

personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system and application titled "AN AUTOMATIC AND ADAPTIVE POWER SUPPLY" describing a multi contact smart power supply.

What is clearly needed, is a better way to allow portable devices to be charged, without requiring plugging in a cable, cradle etc.. that would inhibit their use to some degree while charging.

In some cases, even some of the ways to charge portable devices as described above may have some practical shortcomings. For example, in cases known to the inventors there is a requirement that each conductive section be turned on or off, and the number of sections, in actual practice, is often limited, due to the relatively high cost of switching the sections actively on or off.

For example, even though the technology known to the inventors covers a situation where you would have a thousand sections with a fine resolution, allowing the use of small devices such as key chains, cell phones, ear pieces, etc., which increasingly are smaller and smaller, the cost of such a system, with today's component costs, might be too high to be practical.

What is clearly needed is an alternative approach that allows delivery of the same functionality in a smaller geometry space, without increasing the cost of the switches (too many) to a point where the system becomes infeasible or too expensive to use.

Description of the preferred embodiment

Connecting

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other as the "Adapter" but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the 'relative placement' or "Placement" in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS. The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

1. Contact A1 of the Base touches contact B1 of the Adapter;
2. Contact A2 of the Base touch contact B2 of the Adapter;
3. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. (only array shown) Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Powering

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load

and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 5 shows a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 6 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple mechanical or relay type switches, as indicated here for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination or any passive or active circuit, even inductors and capacitors can be used to convey presence and parameters to the base. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load or, in some cases, the adapter can have intelligence to disconnect the load until it establish a connection or gets power from the base, this may be useful for example for resistive loads.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts. In some cases, the power base may disconnect on sense of the device current usage pattern.

Fig. 7 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device. It is clear to person skilled in the art, that rather than having a number of fixed voltage rails, for example two programmable rails may be used, and the parameters reported back from the ID device may help select the voltages.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

System

Combining the above-described elements into a complete system allows the user to have more freedom when using a notebook computer, for example, at a desk or similar prepared type of environment, such as a home office, a hotelling situation in a corporate environment, or even at a kiosk in an airport or other public place.

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desk mat may be integrated into a part of the desk surface, rather than being a separate mat, but for the near future it will be easier to replace regular desk mats with these conductive types of desk mats.

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Cabling system 803 is hidden away behind the desk through an opening and connects to a power supply unit 802 that contains both the power source itself and the sensing and switching capability as described above. Power cord 804 with power connector 805 plugs into a regular household ac outlet, of the type available in normal homes and offices.

Figure 9 shows one case, in which the Adaptor Piece as attached to a notebook 900. The notebook is shown from the lower rear, with a view of notebook base 902 and notebook lid 901, which is slightly open. Adaptor piece 910 is attached to the bottom of the notebook using, for example, hook-and-pile fastener or mounting tape, or any other suitable fastening method, including but not limited to screws, bolts, glue, cement, snaps etc.. Adaptor piece 910 has, in this example, three separate areas 911, 912, and 913, wherein areas 911 and 913 may be conductive surfaces and area 912 is an insulator. Cable 920 plugs into the regular power supply of the notebook. Also shown is a wireless Ethernet card 930 protruding from the PCMCIA slot, a typical situation with notebook computers. In some cases, the adaptor may be an integral part of the notebook's enclosure, or in some cases more specifically also integrated with the battery or its enclosure, hence not requiring a special cable, or an attachment. Also, in case of a cable mentioned above, a convenience receptacle may be offered, so the user

does not have to unplug the adapter piece in case of using a regular charger w/base. In some of these cases, the adapter may be electrically disconnected, as to avoid hazards by exposing hot contacts.

Figure 10 shows an overview of the notebook 900 placed freely on the desk 801 of Figure 8, as an example of a system setup. Notebook 900 is depicted as placed at an odd angle, to exemplify that such a device may, according to the novel art of this disclosure, be placed in any kind of position in this example on mat 800, allowing for the system to charge while the notebook is in use, without having to plug in any cables or carry any power supplies.

Many variations may be made to the system as presented herein without departing from the spirit of the novel art of this disclosure.

Contacts 911,912 & 913 of adaptor piece 910 may be round rather that square; its dimensions may match those of the notebook base, rather than being scaled to a functional minimal size, following the rules proposed earlier; adaptor piece 910 may connect to a docking connector available on the bottom of some notebooks, rather than to the power cord. Or, in a preferred mode, adaptor piece 910 may be integrated into the standard enclosure of a notebook, eliminating the need for a separate, add-on device.

Desk mat 800 may also have many variations. It may be used in conjunction with a standard power supply provided by the notebook manufacturer and contain by itself only the sensing and switching functionality, rather than the full power supply.

In yet other cases, the system may also be used to transmit data over the established electrical connections, rather than just power. That may be achieved by either using additional contacts, as is proposed earlier, or by modulating the signal(s) onto the existing power leads, and adding a filter (i.e. inductor/cap) to separate the dc supply and the high speed data signals, such as Ethernet etc. In such cases, an Ethernet port may be offered on both the desk mat 800 (not shown) and a cable on adapter piece 910 (not shown). Other network standards besides Ethernet may also be supported, as desired or required by the market, both current and future ones. In some cases yet, wireless methods may be used for the data, such as optical including InfraRed (IR),

inductive coupling, capacitive coupling, or radio frequency with or without some modulation techniques. That may include virtual docking connections or regular Local Area Network connections or both.

Many variations may be formed by shifting the partitioning or integration of features among various elements. In some cases, for example, the mat may be integrated into the desk; in other cases, it may be a foldable or rollable mat, reduced in size for easy portability, for the convenience of travelers. Further, in some cases input devices may be integrated in the base (e.g. a tablet or a large touch pad), the pad surface may be extra mouse friendly (both for mechanical and optical mice), or it may also be used to powering semi-mobile devices such as desk lamp or electric stapler etc. Additionally, there are advantages to ensure that the pad is an anti static pad (making it even safer than using no pad at all), or some of these extensions may be offered as modules, including making the pad area modular (cut to order, tiles, etc). In some cases, the base provides a standard power and each device/adapter converts it to the level needed by its respective device. Also, in some cases some information and sensing is done in the reversed direction (base to device) and the device also makes some decisions or power switching (e.g. is that base safe for me).

Many other configurations and variations are also possible that do not depart from the spirit of the invention.

Small Geometry Solutions

Figure 11 shows a track system of interleaved plus and minus tracks. The plus tracks are numbered 1100 a, b, and c, and the minus tracks are numbered 1110 a and b. These tracks each have protrusions, similar nails or bolts, rising from the tracks themselves, numbered, respectively, 1102x and 1112x, and they are interleaved. These tracks could be embedded in an injected plastic or engraved wood surface, forming the pad 1101 shown here as a semivisible thickness aspect.

Figure 12 shows a top view. Again, a section of pad 1101 is shown. In this view, only three tracks are shown, creating an interleaving pattern of those rising conductor sections 1102x and 1112x, offset by half a grid from each other. The dots represent

that those rising conductors (feeding points FPs) extend in both directions to whatever size is required.

Figure 13 emphasizes the interesting aspect of such a system as system 1200. Again, the FPs 1102 a-d are shown marked with a plus, and the dots 1112 a-c are shown with minus. FPs 1102 g-j are shown with plus; FPs 1112 g-i are shown with minuses.

Overlaying, in a transparent manner, is a contact pad 1300, containing three contacts. Each contact 1301, 1302, and 1303 is separate from each other contact, and may be used to feed a selection logic that determines which contact has been connected to a plus and which to a minus. In reality, a higher number of contacts such as 5 or more may be required to guarantee at least one contact to a plus FP and one contact to a minus FP, depending both on the geometry of the pad and the contact pad, as well as the contacts and FPs. For better clarity of the diagram however, only 3 are shown (in fact using this geometrical arrangement, it is easy to provide mathematical proof that even 4 contacts do not guarantee always one plus and one minus). The words Plus and minus are to be seen in the broadest terms simply representing to conduits for power, since in some cases, rather than DC, AC may be used, or pulses, or power in conjunction with data etc.

The easiest way to achieve correct connectivity is to use a bridge rectifier to extract the voltage from the FPs and then use that voltage to drive the circuitry (not shown) between contact pad 1300 and a device (not shown), such as a notebook. The circuitry then, using low drop switches (i.e., bipolar solid state switches in parallel to the bridge rectifier), connects the actual contacts of contact pad1300 to the conductors of the notebook charger connector (details not shown).

It is clear that depending on the structure of the protrusions out of the plane (not shown) of the FPs and their sizes and distances between themselves, the contact pads and their contacts must be such that they cannot short between plus and minus FPs, on one hand; and that independent of the positioning on the surface, always at least one plus and one minus are connected.

In yet other situations, a complete rail may surface and depending on the dimensions and distances, the dimensions and distances as well as the geometry of the contact pad 1300 may change. In some situations, a linear array may be better or a T-shape or X-shape, or a honeycomb-cluster-of-contacts, or other suitable multi-port connection may be preferred or required over a basic kind of contact pad. A very suitable candidate seems to be a diamond-shaped contact pad, using four rather than just three contacts in conjunction with an interleaving field of round FPs as shown in Figure 13.

Depending on their sizes and geometry (for example, the FPs may be formed into diamond shapes, covering almost all of the surface with very tiny gaps for insulation, or a honeycomb pattern may be used, or just round dots as shown in Figure 13, or any other type of suitable geometry, and they may have protrusions, for example spherical, cylindrical with or without mitering, pokes etc), more than three or four contacts may be required to guarantee contact to a pair of FPs with opposite polarity to a pair of contacts on the contact pad, with shorting any FPs. A suggested approach to evaluating suitable geometries is model their connectivity by either a computer simulation or a mathematical formula. In many cases, the design of the Fps on the pad will be driven by Industrial Design, and will necessitate all the other dependencies to follow suit.So many different variations are possible that stay within the scope of the invention that it is impossible even to list all the examples, but essentially they all end up doing the same. In some cases, it may be preferable to arrange the contact pad across the whole geometry of the portable device, rather than across only a localized group, thus allowing the weight to distribute across all contacts, ensuring a better electrical contact, rather than having all contacts of the contact pad in one corner, which might lift some of them off, unless they are spring loaded or the pad is pivotally mounted. In some other cases, the contacts may be integrated again in the enclosure of the portable device itself, with internal connections. In some cases, power may be always on to such a pad, and no sensing may be done at all, or only basic short circuit protection may be provided.

Figure 14 shows another example of a pad 1101 whose microstructure has been sectioned into sections 1401 a-n. For example, the plus of each section could be

connected separately through a cable 1410 to adaptive power supply 1420, and the minus throughout the whole pad can stay connected so it is always on.

In such an example, once a device is deposited, only that section containing the device may be activated. Thus different sections of the pad could have different voltages, allowing the device not to require a regulator on the adaptor piece. So a user could then place a cell phone, laptop computer, and PDA all onto surface 1101, and the adaptive power supply would, after identifying each device, turn on either a standard voltage or a voltage specific to each device, depending on whether the devices have voltage adaptors themselves or have only identification switching devices.

Sample CLAIM:

Claim 1: A mobile device power delivery system, having a power supply with two or more electrical contacts in an interleaving arrangement, further a power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, such that, when the of contacts of the load touch contacts of the base unit, the electrical circuit is closed.

Claim 2: A method for power delivery to a mobile device, having a power supply with two or more electrical contacts in an interleaving arrangement, further a power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit,

wherein, i) upon touching of contacts of the load to contacts of the base unit, ii) the electrical circuit is closed.

Appendix E

Application for Provisional Patent

TITLE:

ENHANCED WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

Inventors Tal Dayan
Andy Goren
Dan Kikinis
Bill Maggs

CROSS-REFERENCES TO RELATED APPLICATIONS:

COUPLER WITH THREE DEGREES OF FREEDOM

AN AUTOMATIC AND ADAPTIVE POWER SUPPLY

WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

BACKGROUND **FIELD OF INVENTION:** Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to

recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system and application titled "AN AUTOMATIC AND ADAPTIVE POWER SUPPLY" describing a multi contact smart power supply.

What is clearly needed, is a better way to allow portable devices to be charged, without requiring plugging in a cable, cradle etc.. that would inhibit their use to some degree while charging.

In some cases, even some of the ways to charge portable devices as described above may have some practical shortcomings. For example, in cases known to the inventors there is a requirement that each conductive section be turned on or off, and the number of sections, in actual practice, is often limited, due to the relatively high cost of switching the sections actively on or off.

For example, even though the technology known to the inventors covers a situation where you could have a thousand sections with a fine resolution, allowing the use of small devices such as key chains, cell phones, ear pieces, etc., which increasingly are smaller and smaller, the cost of such a system, with today's component costs, might be too high for mass consumers.

What is clearly needed is an alternative approach that allows delivery of the same functionality in a smaller geometry space, without increasing the cost of the switches (too many) to a point where the system becomes too expensive.

<<CIP ADDITION MW p5>>

Further to the options discussed above, there are new ways and means of implementing essentially the same novel art with nonconductive surfaces. What is clearly needed are an apparatus and a method that allow the implementation of the

above-described goal, using nonconductive surfaces, or additional enhancements for easier control, better performance, etc., when using conductive surfaces.

Description of the preferred embodiment

Connecting

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other as the "Adapter" but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the 'relative placement' or "Placement" in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS. The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

4. Contact A1 of the Base touches contact B1 of the Adapter;
5. Contact A2 of the Base touch contact B2 of the Adapter;
6. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. (only array shown) Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Other options are discussed later in this disclosure.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular

notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

Other options are discussed later in this disclosure.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Powering

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 5 shows a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different

voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 6 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple mechanical or relay type switches, as indicated here for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination or any passive or active circuit, even inductors and capacitors can be used to convey presence and parameters to the base. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load or, in some cases, the adapter can have intelligence to disconnect the load until it establish a connection or gets power from the base, this may be useful for example for resistive loads.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts. In some cases, the power base may disconnect on sense of the device current usage pattern.

Fig. 7 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device. It is clear to person skilled in the art, that rather than having a number of fixed voltage rails, for example two programmable rails may be used, and the parameters reported back from the ID device may help select the voltages.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

System

Combining the above-described elements into a complete system allows the user to have more freedom when using a notebook computer, for example, at a desk or similar prepared type of environment, such as a home office, a hotelling situation in a corporate environment, or even at a kiosk in an airport or other public place.

Figure 8 shows a desk 801 on which a desk mat 800 is placed. The desk mat is built according to the descriptions mentioned above. In the future, in some cases such a desk mat may be integrated into a part of the desk surface, rather than being a separate mat, but for the near future it will be easier to replace regular desk mats with these conductive types of desk mats.

Further, by using different techniques, the appearance may be changed dramatically. For example, a conductive plastic may be applied in a thin layer on top of a metallic conductor interleaved with non conductive material surrounding both the conductive plastic and metal. In other cases, metallic areas may be silk-screened with color, leaving sufficient openings for contact. In yet other cases, acidic etching into the metal may create openings to deposit colored resin, similar to anodizing of aluminum. In yet other cases, chrome-plated or nickel finished round metal spots may be embedded in a black rubber mat, for creative design. All these approaches can be used to make a desk mat product to be visually appealing to consumers, but essentially do not diverge from the invention disclosed here.

Cabling system 803 is hidden away behind the desk through an opening and connects to a power supply unit 802 that contains both the power source itself and the sensing and switching capability as described above. Power cord 804 with power connector 805 plugs into a regular household ac outlet, of the type available in normal homes and offices.

Figure 9 shows one case, in which the Adaptor Piece as attached to a notebook 900. The notebook is shown from the lower rear, with a view of notebook base 902 and notebook lid 901, which is slightly open. Adaptor piece 910 is attached to the bottom of the notebook using, for example, hook-and-pile fastener or mounting tape, or any other suitable fastening method, including but not limited to screws, bolts, glue, cement, snaps etc.. Adaptor piece 910 has, in this example, three separate areas 911, 912, and 913, wherein areas 911 and 913 may be conductive surfaces and area 912 is an

insulator. Cable 920 plugs into the regular power supply of the notebook. Also shown is a wireless Ethernet card 930 protruding from the PCMCIA slot, a typical situation with notebook computers. In some cases, the adaptor may be an integral part of the notebook's enclosure, or in some cases more specifically also integrated with the battery or its enclosure, hence not requiring a special cable, or an attachment. Also, in case of a cable mentioned above, a convenience receptacle may be offered, so the user does not have to unplug the adapter piece in case of using a regular charger w/base. In some of these cases, the adapter may be electrically disconnected, as to avoid hazards by exposing hot contacts.

Figure 10 shows an overview of the notebook 900 placed freely on the desk 801 of Figure 8, as an example of a system setup. Notebook 900 is depicted as placed at an odd angle, to exemplify that such a device may, according to the novel art of this disclosure, be placed in any kind of position in this example on mat 800, allowing for the system to charge while the notebook is in use, without having to plug in any cables or carry any power supplies.

Many variations may be made to the system as presented herein without departing from the spirit of the novel art of this disclosure.

Contacts 911,912 & 913 of adaptor piece 910 may be round rather that square; its dimensions may match those of the notebook base, rather than being scaled to a functional minimal size, following the rules proposed earlier; adaptor piece 910 may connect to a docking connector available on the bottom of some notebooks, rather than to the power cord. Or, in a preferred mode, adaptor piece 910 may be integrated into the standard enclosure of a notebook, eliminating the need for a separate, add-on device.

Desk mat 800 may also have many variations. It may be used in conjunction with a standard power supply provided by the notebook manufacturer and contain by itself only the sensing and switching functionality, rather than the full power supply.

In yet other cases, the system may also be used to transmit data over the established electrical connections, rather than just power. That may be achieved by either using additional contacts, as is proposed earlier, or by modulating the signal(s) onto the

existing power leads, and adding a filter (i.e. inductor/cap) to separate the dc supply and the high speed data signals, such as Ethernet etc. In such cases, an Ethernet port may be offered on both the desk mat 800 (not shown) and a cable on adapter piece 910 (not shown). Other network standards besides Ethernet may also be supported, as desired or required by the market, both current and future ones. In some cases yet, wireless methods may be used for the data, such as optical including InfraRed (IR), inductive coupling, capacitive coupling, or radio frequency with or without some modulation techniques. That may include virtual docking connections or regular Local Area Network connections or both.

Many variations may be formed by shifting the partitioning or integration of features among various elements. In some cases, for example, the mat may be integrated into the desk; in other cases, it may be a foldable or rollable mat, reduced in size for easy portability, for the convenience of travelers. Further, in some cases input devices may be integrated in the base (e.g. a tablet or a large touch pad), the pad surface may be extra mouse friendly (both for mechanical and optical mice), or it may also be used to powering semi-mobile devices such as desk lamp or electric stapler etc. Additionally, there are advantages to ensure that the pad is an anti static pad (making it even safer than using no pad at all), or some of these extensions may be offered as modules, including making the pad area modular (cut to order, tiles, etc). In some cases, the base provides a standard power and each device/adapter converts it to the level needed by its respective device. Also, in some cases some information and sensing is done in the reversed direction (base to device) and the device also makes some decisions or power switching (e.g. is that base safe for me).

Many other configurations and variations are also possible that do not depart from the spirit of the invention.

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Figure 11 shows a track system of interleaved plus and minus tracks. The plus tracks are numbered 1100 a, b, and c, and the minus tracks are numbered 1110 a and b. These tracks each have protrusions, similar nails or bolts, rising from the tracks themselves, numbered, respectively, 1102x and 1112x, and they are interleaved. These

tracks could be embedded in an injected plastic or engraved wood surface, forming the pad 1101 shown here as a semivisible thickness aspect.

Figure 12 shows a top view. Again, a section of pad 1101 is shown. In this view, only three tracks are shown, creating an interleaving pattern of those rising conductor sections 1102x and 1112x, offset by half a grid from each other. The dots represent that those rising conductors (feeding points FPs) extend in both directions to whatever size is required.

Figure 13 emphasizes the interesting aspect of such a system as system 1200. Again, the FPs 1102 a-d are shown marked with a plus, and the dots 1112 a-c are shown with minus. FPs 1102 g-j are shown with plus; FPs 1112 g-i are shown with minuses.

Overlaying, in a transparent manner, is a contact pad 1300, containing three contacts. Each contact 1301, 1302, and 1303 is separate from each other contact, and may be used to feed a selection logic that determines which contact has been connected to a plus and which to a minus. In reality, a higher number of contacts such as 5 or more may be required to guarantee at least one contact to a plus FP and one contact to a minus FP, depending both on the geometry of the pad and the contact pad, as well as the contacts and FPs. For better clarity of the diagram however, only 3 are shown (in fact using this geometrical arrangement, it is easy to provide mathematical proof that even 4 contacts do not guarantee always one plus and one minus). The words Plus and minus are to be seen in the broadest terms simply representing to conduits for power, since in some cases, rather than DC, AC may be used, or pulses, or power in conjunction with data etc.

The easiest way to achieve correct connectivity is to use a bridge rectifier to extract the voltage from the FPs and then use that voltage to drive the circuitry (not shown) between contact pad 1300 and a device (not shown), such as a notebook. The circuitry then, using low drop switches (i.e., bipolar solid state switches in parallel to the bridge rectifier), connects the actual contacts of contact pad1300 to the conductors of the notebook charger connector (details not shown).

It is clear that depending on the structure of the protrusions out of the plane (not shown) of the FPs and their sizes and distances between themselves, the contact pads and their contacts must be such that they cannot short between plus and minus FPs, on one hand; and that independent of the positioning on the surface, always at least one plus and one minus are connected.

In yet other situations, a complete rail may surface and depending on the dimensions and distances, the dimensions and distances as well as the geometry of the contact pad 1300 may change. In some situations, a linear array may be better or a T-shape or X-shape, or a honeycomb-cluster-of-contacts, or other suitable multi-port connection may be preferred or required over a basic kind of contact pad. A very suitable candidate seems to be a diamond-shaped contact pad, using four rather than just three contacts in conjunction with an interleaving field of round FPs as shown in Figure 13.

Depending on their sizes and geometry (for example, the FPs may be formed into diamond shapes, covering almost all of the surface with very tiny gaps for insulation, or a honeycomb pattern may be used, or just round dots as shown in Figure 13, or any other type of suitable geometry, and they may have protrusions, for example spherical, cylindrical with or without mitering, pokes etc), more than three or four contacts may be required to guarantee contact to a pair of FPs with opposite polarity to a pair of contacts on the contact pad, with shorting any FPs. A suggested approach to evaluating suitable geometries is model their connectivity by either a computer simulation or a mathematical formula. In many cases, the design of the Fps on the pad will be driven by Industrial Design, and will necessitate all the other dependencies to follow suit.So many different variations are possible that stay within the scope of the invention that it is impossible even to list all the examples, but essentially they all end up doing the same. In some cases, it may be preferable to arrange the contact pad across the whole geometry of the portable device, rather than across only a localized group, thus allowing the weight to distribute across all contacts, ensuring a better electrical contact, rather than having all contacts of the contact pad in one corner, which might lift some of them off, unless they are spring loaded or the pad is pivotally mounted. In some other cases, the contacts may be integrated again in the enclosure of the portable device itself, with internal connections. In some cases, power may be always on to such a pad,

and no sensing may be done at all, or only basic short circuit protection may be provided.

Figure 14 shows another example of a pad 1101 whose microstructure has been sectioned into sections 1401 a-n. For example, the plus of each section could be connected separately through a cable 1410 to adaptive power supply 1420, and the minus throughout the whole pad can stay connected so it is always on.

In such an example, once a device is deposited, only that section containing the device may be activated. Thus different sections of the pad could have different voltages, allowing the device not to require a regulator on the adaptor piece. So a user could then place a cell phone, laptop computer, and PDA all onto surface 1101, and the adaptive power supply would, after identifying each device, turn on either a standard voltage or a voltage specific to each device, depending on whether the devices have voltage adaptors themselves or have only identification switching devices.

<<CIP ADDITION MW p5>>

Various Ultimate Apparatuses and Methods for Implementing a Wireless Power Supply System

Figure 15 shows pad 1500 made of either conductive or nonconductive material, which has some thickness to it. Inside the pad is an inductor 1501 that can be positioned by moving arms 1510 and 1520, using, in this example, screwdrive mechanism 1511 and motor 1512 for arm 1510, and likewise screwdrive mechanism 1521 and motor 1522 for arm 1520. Other mechanisms, such as belt drives, scissor arms, etc., may be used in lieu of this example screwdrive and motor arrangement.

Notebook 1542 has a matching inductor 1502 that may contain some circuitry. A cable 1503 comes out of the circuitry and enters the notebook 1542 standard charging circuit. In some cases, inductor 1502 may be integrated into the notebook.

As the notebook 1542 is placed on the surface of pad 1500, the controlling motors 1512 and 1522 (not shown for reasons of simplicity) are activated, for example by a command, pushing a button, weight detection, or other, similar means (described in more detail later) to detect the position of the notebook 1542 and the location of inductor 1502. This search can be performed by a controller, which may be embedded

in the pad 1500 (not shown), or may be part of the power supply (also not shown), or may in some cases be controlled by the notebook itself, sending data to a small controller/receiver unit (also not shown). By scanning the surface of the pad, said controller aided by motors 1512 and 1522 can detect an area (i.e., a "sweet spot") where optimal or near-optimal coupling may be achieved, thus deducting that inductor 1502 is located on the pad surface above.

In some cases, inductor 1502 may send out a homing signal that may be used to track the location of notebook 1542. In other cases, inductor 1501 may send out a ping signal and listen for some kind of resulting echo response from inductor 1502. In yet other cases, as described also further below, other sensor types or optical detection can also be used to guide the search for the sweet spot.

Once the sweet spot area has been found, small-step increments allow positioning the inductor more accurately, and hence allow the power to be increased once satisfactory magnetic coupling is achieved. If the user were to move notebook 1542, the magnetic coupling quality would fall, which could be observed by the adaptive power supply, resulting in shutting off the power and initiating a new search sequence, reconnecting the notebook to charging again.

Figure 16 shows a different approach using an array of inductors 1601 a-n embedded in a pad 1600, which may be either conductive or nonconductive, each separately connected to a controller 1602, which then is connected by a wire 1603 to a power supply. Notebook 1642 has a larger inductor, 1612 that, in any situation, should include at least one or several instances of inductor 1601 a-n, but in some cases it may have also several inductors with or without electronic switching. Depending on the geometries of the positions of 1601a-n and the receiver coil 1612, power can then be turned on to one or more of the inductors 1601 a-n, thus improving coupling between the receiving coil 1612 and the emitting coils of inductors 1601 a-n.

In yet another approach, Figure 17 shows a capacitive coupling system. Pad 1700, which may be either conductive or nonconductive, although non-conductive is preferred, is divided into an array of electrodes 1701 a-n. Notebook 1742 has two distinct surfaces 1712 a and b, which are connected to a power receiving unit 1714.

Said unit 1741 is, in turn, connected to a cable to a power adaptor plug of notebook 1742.

Figure 17b shows that, based on determination of the notebook position, the electrodes 1701 x1 and x2 are selected from available electrodes 1701 a-n, forming a capacitive transformer with notebook electrodes 1712 x1 and x2. Hence power is fed into power preparation circuitry 1714, and then connected by cable 1715 to notebook 1742.

In some cases, the pad can also be a combination, that is, one 'wire' is conductive (e.g. ground) and the other is capacitive.

Figure 18 shows a few alternative methods for activation and determination of location of the notebook. For example, pad 1800 (which may be a conductive or nonconductive pad, according to any of the methods described above) is partitioned into sections. Each section 1801 a-n may contain a sensor element 1811 a-n. In some cases, this sensor element may be a photo sensor. In other cases, it may be a simple mechanical pressure switch. In yet other cases, it may be a piezo pressure or weight sensor, etc.

According to data obtained by the sensors, the position of a device may be determined, and, using information such as weight and footprint, in some cases even the device ID may be sensed.

In yet other cases, the piezo sensors may pick up ultrasonic signals emitted by the notebook, or said sensors may ping the notebook, which then responds with an echo giving its location and type.

Alternatively, a camera 1821 may take a picture of pad 1800 and see a device deposited on said pad. Image recognition means associated with the camera may recognize the model and type of the device, as well as its orientation, and may instruct the adaptive power supply or one of the nonconductive systems to activate power accordingly.

In yet another implementation, a voice recognition system 1832 may have a microphone 1831 connected to it. The user may then simply say, "Please charge my

Sony™ notebook," and accordingly, the voice recognition system would instruct the adaptive power supply or the nonconductive pad to turn on power.

In yet other cases, RF triangulation from an 802.11x type network, GPS, or other, similar means, may be used to locate the device and determine whether it is situated on a pad and thence activate that pad (not shown) accordingly. Or in some cases, a button may be provided on the pad itself or on the device that the user has to push to initiate the charging, rather than using automatic initiation of charging. Such a manual initiation of charging would avoid unintentional charge cycles.

In yet other cases, a pad deploying a conductive surface with openings may be placed above another solid conducting surface, separated by an insulating layer with slightly smaller openings (not shown). Ball-like contacts may be spring loaded and protrude from the bottom of a mobile device, some of which will "land" in holes and connect to the lower plane carrying one polarity, the others resting on the top one, connecting to the top layer carrying the other polarity, hence again creating a situation where power can be sent up to a device, without having to plug in any connections, and still maintaining some freedom to move the device.

In yet other cases the current can be redirected to the proper contacts by sensing the pressure exerted by the device on the base. Once a device is atop the base surface, pressure inside the surface determines the location of the device and routes power to the appropriate location.

In yet other cases the current can be redirected to the proper contacts by using optical sensors. Certain sensors embedded on or away from the base could detect an optical signal, such as infrared, generated by the adapter. Based on a formula dependent on the optical signal, the base can redirect power to the proper contacts. In certain embodiments the optical signal may be generated at the base or away from the base and received by the adapter.

In certain embodiments the adapter may be connected, attached, or built into the side of the laptop or mobile device. In the event the adapter is united to the side of the mobile device, the adapter would contain contacts that connect to the bases' contacts. In yet other embodiments, the adapter may be attached to the top of the device or the

screen of the laptop. In such cases, when the laptop screen is fully open the power could transfer from the contact on the base surface to the adapter on the laptop or the mobile device.

Many other approaches may be used to mimic the same method and apparatus, even if some of the details are modified so they do not exactly match the examples presented herein.

Appendix F

Enhanced RF Wireless Adaptive Power Provisioning System for Small Devices

Inventors: Tal Dayan, Ofer Goren, Dan Kikinis and Yehuda Goren

Attorney Docket No. 6041.P006z

Background

This disclosure incorporates by reference co-pending patent application titled "Alternative Wirefree Mobile Device Power Supply Method and System With Free Positioning" filed 08/01/2002, application number ________, Attorney Docket No. 6041.P005.

One other approach for wireless powering of small mobile devices is using inductive coupling. Although mentioned in the co-pending application, it is a tricky approach. Leakage is the biggest problem, but load matching, inducing eddy currents in untargeted objects and hence heating them, or shorting the supply are just a few to mention.

What is clearly needed is a method and system to improve the yield by doing a finely tuned microprocessor-controlled, narrow-band resonance coupling, hence improving the coupling to almost no loss in the near field, and at the same time keeping the far field virtually zero.

Description of the Embodiment

Figure 1 shows a pad 100 in which a coil 101 is embedded. The coil is driven by a power oscillator 102 (power source not shown) and is controlled by intelligent controller 103, which may contain a microcontroller. Also shown is the near field 110 and the far field 111, which are available. The near field is defined typically as the field within the geometry size of the coil itself (i.e., if the coil is 5 inches in diameter, the near field would be that order of magnitude, whereas a point 50 inches away would be considered in the far field), while the far field is typically defined as the field seen from a distance of a multiple of the geometry of the device. Typically measurements for EMI are done at a distance of approximately 5 meters or more from the device, and actually they are mostly measuring the far field,

whereas near field sniffer ports are used only for determining potential leaks, etc.

Figure 2 shows a notebook computer 200 with a coil 201 attached to its bottom. Also attached is an RF-to-dc converter 202 and a dc plug 203 that is connected to converter 202 and plugged into a normal dc power supply pin of the notebook. It is clear that in some cases, the receiving system consisting of coil, RF/dc converter, etc., may be integrated into the host and not require an external supply connector. In some cases the RF-to-dc converter is an intelligent-type regulator, in other cases, it may be simply a basic diode/capacitor rectifying system or any type in between. As described earlier in co-pending patent application number _______, Attorney Docket No. 6041.P005, an array of coils can be used to improve coupling by always allowing a "reasonable" set of inductors/antennae to be found between the base and the device. A normal type of MOSFET can be used to switch, using a small dc bias to enable switching and sending the RF energy on top.

Figure 3 shows a schematic overview of the electrical circuitry of the system. Power generator 102 drives the inductor coil 101 in the pad. In some cases, the inductor may not be an actual coil, but rather an antenna with microwave strips, etc., depending on the frequency selected. In yet other cases, it may be integrated into a PCB, etc. Typically, such a device would operate in either the 900 megahertz or in the 2.4 gigahertz range, but almost always in an industrial, scientific and medical (ISM) band, so slight leakage in the far field would be deemed acceptable. In one case, a 13.5 MHz ISM band is used, with a plurality of coils embedded in the base unit. That frequency (also an ISM band) lends itself nicely, since it is high enough to not require expensive ferrite cores, but is low enough to provide high power with little skin effect. Trying to reduce skin effect could dramatically increase the cost of the coils. The switches used in a matrix, as described above, should have a transit frequency of at least 5x the primary carrier (i.e., Ft =100 MHz > 5*13.5 = 67.5 MHz), which are still economically feasible.

Regulator 103 shows more detail. In particular, it measures the power sent into the coil 101 by the means of sensing across the voltage wires and measuring at sense resistor 104 to determine how much power is actually drawn. The results would then be used by regulator 103 (i.e., a microprocessor, not shown) to drive the controls of the oscillator 102. These controls may include one or more of the frequency, frequency spread (that is, the bandwidth), and total power pushed into the inductor (or transmitting antenna) 101.

The recipient antenna or inductor 201 forms, with capacitor 201a (previously not shown), a resonance receiving antenna system that is narrowly tuned. The higher the Q (quality quotient of the resonance circuit), the narrower the band it draws power on, and the better the coupling between the two, even if the mechanical situation is not ideal. Converter 202 is the ac or RF-to-dc converter, shown here with a bridge rectifier capacitor, an electronic regulator block, and another filter capacitor before going to dc connector 203.

The quality of this circuitry may depend a lot on the Q , but also on the capability to control multiple loads. In some cases, a regulator may be contained in the host device, such that communication received in the host side regulator could include, for example, FM-modulated, AM-modulated, or other data that runs on the same carrier (frequency) that is carrying power, and such data can be introduced by controller 103 by modulating the center frequency of oscillator 102, or other appropriate means to achieve the desired type of modulation (not shown).

Figure 4 shows a further simplified circuitry with the oscillator 102, the intelligent controller 103, the sensing resistor 104, and a load resistor 401 that represents the equivalent power load that is "seen" from the oscillator, in the case of an ideal resonant coupling of both coils and or antennae.. The reactive component of Z_L, which can be determined by regulator/controller 103' using its sense lines over Sense Resistor 104 (R_S) lets regulator 103' determine coupling and transmission (transformation) ratio, of the actual situation, allowing a crude first regulation that compensates for the transformation ratio between inductors. Further, the communication link allows fine tuning by communicating between both sides. The back pass of the communication may be done by modulating the load signal, resulting in a specific pattern at the gross regulator on the primary side.

It is clear that by managing the power regulation on the receiving side, the semblance of Z_L may be tweaked. It is also clear that by controlling multiple devices and communicating among said devices, an overload of the circuitry, for example, may be avoided, in case too many devices try to share one pad. A signal could be sent that allows only certain devices to participate, with others being told to delay charging. In yet other cases, the frequency of resonance of different devices may be slightly skewed, thus allowing multiplexing of power distribution by not tightly coupling all devices at the same time. Such an approach would be suitable for the times when greater amounts of power are needed in one or another device, because only certain devices would receive energy at a given time, depending on their resonances. Multiplexing could be done by frequency hopping on the oscillator side, or by other means, such as communicating and telling power regulators to back off.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novelty of the art of this disclosure.

Appendix G

ENHANCED RF WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM

Inventors: Tal Dayan, Ofer Goren, Dan Kikinis, Yehuda Goren

Attorney Docket No. 6061.P007z

Background

With the advent of wireless power services commercially available to the public, there will be demand for such services in public places such as, for example, coffee stops, bus stations, air ports, hotel lobbies, buses, even airplanes, etc. Even though power consumed per user is not that great, when multiplied by millions of users, the cost of consumed power can become a valid business consideration. Also, this technology lends itself to allowing high bandwidth network communications, and therefore, a billing mechanism may be desired.

What is clearly needed is a method that allows an established account user to have a billing mechanism to bill him for actual usage or for a flat fee, and in any case to verify the permissions that the user has and accordingly enable and disable access to power, the network, etc.

Description of the Embodiment

Figure 1 shows a table 101 in a coffee shop 100 that has, for example, four sections 102 a-d. On one of the sections (section 102b) the user has installed himself by setting down his notebook 105, his cell phone 106, and half a cup of cappuccino 110.

Figure 2 is an overview diagram of the network connectivity required. In this example, only cell phone 106 is shown, sitting on table section 102b; however, it is clear that more than one device may be connected at one time. Table section 102b is connected to intelligent controller 201, which has access to a power source 203 and also access to network 204, typically going through a router/firewall device 205 and Internet connection 211 to the Internet 210, from where a connection 212 leads to a server 220 that maintains the user's account.

According to the user's preferences an account has been set up on the server that describes the features of the account, such as power, networking, etc., and the means of payment, for example, by time and/or actual power usage and/or megabytes of data uploaded or downloaded. All this data for each account is on file in a database (not shown) on the server.

The account services may be charged as a flat monthly fee, and a record of the megabytes used kept only for internal usage, or the account may be billed by megabytes transferred. The fee structures may be in place for power usage: it may be billed as a flat fee for usage, or the fees may be on an hourly basis, where, for example, the user gets X hours of charging time, regardless of whether he uses the power for one or for multiple devices.

To invoke the account services, the user may go to a Web site where he can register his devices to his account. Hence when the device ID comes up, the server knows which account permissions to retrieve.

Figure 3 shows a simplified flow diagram of the process of the novel art of this disclosure. In step 301, a device is set on the table section. In step 302, the presence of the device is detected. In step 303 the ID is obtained from the device, as described above. In step 304, that ID is sent to the server and is looked up to identify the user account. Then in step 305, according to the account permissions, a record that OKs the usage and gives limits, rates, etc., is sent back and received. In step 306, the power and/or network restrictions for an unauthorized user are lifted, and the user is free to use power and networking services provided by his account for his device.

The structure of the database is not described here in detail, but no special technique is required. It is well known in the art how to design databases that can look up, for example, an ID that is associated with an account and can obtain account-related information.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novelty of the art of this disclosure.

Appendix H

Modifying Surfaces of Devices to Integrate Them Into Wireless Charging Systems

CIP MW 005 and 006 (inductive)

Inventor Tal Dayan, Ofer Goren, Pandurangan Ramakrishnan, Dan Kikinis
6041.P008z

Co-pending provisional applications MW 006, MW 007 are incorporated by reference.

Background

Very often an existing portable device needs to be upgraded to support wireless power. However, gluing contacts on the outside may not always be suitable, for various reasons. For one reason, the contacts may be torn off easily from a device such as, for example, a notebook computer, which is pushed in and pulled out of a carrying case frequently, where the contacts may easily catch on the zipper, etc. For yet another reason, some devices may have a pronounced curve to their external plastic surfaces, which may reduce that ability to make a proper connection or easy gluing of an add-on solution. [2:00]

[2:40]Figure 1 shows an example in current art of a cell phone 100 that has a removable battery pack 111. The battery pack is attached to the outside enclosure of the phone, as shown by dotted line 101. The battery pack has a latch 112 that hooks into a slot 102 on the cell phone to facilitate removal of the pack and attachment of the pack to the phone. Typically, such a battery pack has at least two contacts, shown here as contacts 113 a-n on the pack, that match with a set of contacts 103 a-n on the phone when the battery pack is attached to the phone, as suggested by arrow 120. [3:30]

[3:30]Figure 2 shows a similar system, but of the type where the battery and its enclosure are two separate parts. Again, the position of the battery when attached to the phone is shown by dotted line 101in the outline of the phone 100. However, in this example, the battery 211 with contacts 113 a-n is separate from the battery cover 221, which has a latch 212. The cover has to be put on after the battery is properly situated and connected. Depending on the system, the battery, rather than just having contacts, may have a short cable (not shown) with connectors that plug into a connector on the phone to secure the contacts. After the battery contacts are plugged into the phone contacts, then the cover 221 is put on over battery 211 *in situ* in phone 100. [4:33]

[2:00]What is clearly needed is a system wherein a battery pack, for example, or an enclosure of a battery pack, or an enclosure of a device may be replaced by one that has integrated contacts, thus avoiding the problems or providing a solution to the problems that would arise out of gluing on additional contacts. Furthermore, such or further additional contacts may be designed to allow powering of a second device in addition to the original, primary device. [2:40]

Description of the Embodiment

[4:36]Figure 3 shows a phone of the style shown in Figure 1, but with multiple alternatives of the novel art of this disclosure. For example, battery pack 111b has been changed to contain an active area 320, as described in previous co-pending applications. Pack 111b shows the battery pack flipped upside down, so now the contacts 313a and 313b are visible, as well as a dotted line that indicates the control circuitry 314 that has been added inside the battery pack. Even though the example discussed is a cell phone, essentially the same applies for all kinds of portable electronic, including, but not limited to cell phones, notebooks, PDA's, still and video cameras, portable video and audio players, any hybrid combinations and other mobile, not yet conceived devices etc.

Often battery packs already contain some circuitry, so rather than a separate add-on, additional new circuitry could be simply integrated into the internal circuitry of the battery pack, such as in area 320. Therefore, the phone would not "see" any change in its electrical capabilities. Some batteries in current art already have external contacts that allow the battery to be charged from the outside while the phone is, for example, in a cradle in a car or on a desktop. Those external contacts could be used for the activities of the novel art of this disclosure as well by extending the contact sizes to match the requirements of the upgraded system.

Those additional shell parts, batteries, contact sets and wires may be sold as upgrades, much like faceplates for phones are sold today in retail stores, often as an after market module. In some cases however, the changes, upgrades and additions may pertain to other subsets of a system than just shell or battery, including but not limited to memory card, CD player, other attachable peripherals etc.

Additionally, on the phone body 100 itself the top portion of the cover may be removed and replaced with a cover that has integrated contacts such as contacts 323a and 323b. Circuitry 314 could be hidden under contact 323b, and a connection to the phone 100 could be established through wires 324 and 325. Similar replacements are made today for purposes of cosmetic upgrades to cell phones. For example, in many cell phones the face plate can be changed, and for some cell phones, kits are available to add lighting effects to such a cosmetic cover, including a wire that is inserted between the phone and the battery to power the LEDs that generate the lighting effects. Wire 325 may be connected in a similar way to interface between the phone 100 and the battery 111b. If such modification are introduced, the cover could in some cases for example, have contacts that allow a second phone or other, similar device to be powered while the primary battery is charged. [7:25]

Figure 4 shows an approach for a battery pack that has a separate cover, as previously shown in Figure 2. The novel art is similar to that described for Figure 3, above; however, because the batteries in this situation often have wires, the battery may be, for example, plugged into circuitry 314, which is contained in battery cover 221b (221b from the other view). That circuitry would then have a wire 430 that connects to the phone instead of a wire or wires from the battery (not shown). In other cases where the battery doesn't have its own wire, a wire may be inserted between the battery and the phone to properly connect and be able to charge the battery and power the phone. [8:25]

Figure 5 shows another approach, for a notebook computer. it is a further elaboration of the case

discussed above, where contacts are added to the case or shell, allowing a second device to be charged and or powered. In this example, notebook 501 typically has a base side 503 and a lid 502 that can be flipped up. It stands on active surface 500, which is connected via cable 520 to power supply 521, which in turn is connected through wire 522 to main ac power. On the top of lid 502, the outer covering has been replaced to contain an active area 510, as described in previous co-pending applications, where devices such as a couple of cell phones, PDAs, or other, similar devices may be charged. The control circuitry may be included in the device, such as the notebook, or in other cases, the contacts offered may just be a pass thru, and control comes from the main control unit of the main pad, surface etc.

As discussed earlier <<note to attorney: in previous apps)>> other methods than direct contact may be used, such as the other wire free charging methods (induction, RF, capacitive etc) , and those components may be integrated in a similar analogous manner into replacement shells etc.

When replacing the battery and or the shell or components thereof, mechanical changes to the original design may be made. For example, the new battery can be larger to contain room for necessary electronics, elongated to touch an existing power input contactor or the shell may have a different shape (e.g. flat) than the original.

Appendix I

Enhanced Contact Systems for Surfaces and Devices

CIP MW 008

Inventors: Tal Dayan, Ofer Goren, Pandurangan Ramakrishnan, Dan Kikinis

6041.P009z

Background

The system discussed in co-pending application titled "MODIFYING SURFACES OF DEVICES TO INTEGRATE THEM INTO WIRELESS CHARGING SYSTEMS", Attorney Docket No. 6041.P008z, filed 09/17/2002, and the co-pending applications referenced therein requires in some cases that the contacts on the device and its corresponding surface must have a satisfactory contact. In particular, if a device has more than three legs there is, at least theoretically, the chance that one of the legs may not touch. If said non-contacting leg is a contact leg, the non-contact may likely result in a malfunction of the system.

What is clearly needed is a system with a mechanism that by spring-loading or other means allows the contacts to have additional freedom of movement to improve the chances of proper contact between the leg and the matching area on the corresponding surface.

Description of the Embodiment

Figure 1 shows the bottom of a device 100, which could, for example, be a PDA or notebook. The bottom case shell 110 of device 100 has standard rubber feet 101a and 101b. It has also two special contact feet 102a and 102b. A cross section AA of a standard rubber foot 101b is shown in more detail in Figure 2, and a cross section BB of the enhanced foot according to the novel art of this disclosure is

shown in Figure 3. It is important to the novel art of this disclosure that feet 102a and 102b have additional freedom in their range of motion so they can move forward and backward as indicated by motion arrow 114, left and right as indicated by motion arrow 113, and vertically as indicated by motion arrow 112. The range of motion indicated by motion arrow 112 is the most important, to guarantee that all four legs, and in particular contact legs 102a and 102b, properly contact the required areas of the corresponding surface.

In some cases, a unit may, as shown in Figure 8, use only two feet (both conductive), as shown in Figure 8a and Figure 8b, or three feet (at least two of which are conductive), as shown in Figure 8c, such that the two conductive feet (indicated by shading in the outline of the feet in Figure 8c) are guaranteed to touch the surface, eliminating the need for flexibility in the z axis.

Figure 2 shows the cross section AA of a standard rubber foot 101b. Typically a holding form or shape is molded into the shell 110. A rubber foot cutout in a matching format 101b is inserted and typically secured with glue (not shown). In some designs other methods of securing the foot to the shell may be employed, such as pins, screws, stakes, wedges, notches, etc.

Figure 3 shows a cross section BB of foot 102a, with motion arrows 112, 113, and 114 showing the range of motion. It is important to the novel art of this disclosure that bottom shell 110 has a holding shape 316 molded to it. Conductive foot material forms a disk 302, which in this example is held back by a bolt 301 and is spring-loaded by spring 303. In other designs, a foam material, for example, may be used instead of a spring. This arrangement allows the required freedom of range of motion indicated by arrows 112, 113, and 114. A gap 314 between the conductive foot 302 and the retainer ring 316 (holding shape) provides space for horizontal range of motion in all directions; while the spring extension 303 provides space for the required vertical range of motion by pushing the bolt head 301 into the device. Also important is wire 315, which connects to bolt 301 and delivers the electricity to the circuitry inside the device (not shown).

Various modifications to the details of this design may be made; for example, multiple springs may be used instead of one spring, or multiple bolts may be used instead of one bolt. Also, the shape of the foot may be triangular, square, elliptic, or any other shape, instead of just round.

Figure 4 shows an enhanced method for low-cost manufacturing of the conductive pad. A small section 400 has four contacts. The pad, depending on its design, may have multiple sections, each with multiple contacts. These contacts may be stamped from a sheet of slightly springy steel 400. There is a cross-connect 401 between the rows and the rows 402a, 402b, etc. In each row is a number of contacts, such as 410a1, 410a2, etc., and 410b1, 410b2, etc. Depending on the size of the total pad, there may be a more, even many more, sections 400, and each section may have its own set of connected contacts, where as neighboring sections are isolated from one another and connect to the controller as described in the earlier applications.

In other cases, the sheet metal may have many other shapes, such as, for example, stamped bumps instead of raised flaps. Also, it may be made of separate pins or rivets that are inserted into the metal sheet, as long as parts of the metal are exposed in the top layer or protrude from it. In yet other cases, the sheet metal may be molded into the plastic or the plastic may be molded separately and then the metal contacts may be inserted into the plastic. Also, the exposed metal contacts may form an aesthetic pattern,

have any of various different sizes and shapes, etc.

Figure 5 shows a side view of the same stainless steel sheet section 400. Cross-connect 401 is at the end and members 402 a-n (all one behind another) are going across, and contacts 410 a-n1, 410 a-n2, etc., are distributed along. Since all contacts in a section line up, they can not be seen individually.

Figure 6 shows a small section with one contact of the sheet 400 in a mold. Cross member 402 a-n rests on distance pins 610 a-n, which are strategically placed throughout the mold. Spring contacts 410 a-n #1-n touch the upper side of the mold at contact points 611 a-n #1-n. Depending on the design, there may be a slight cavity, which will result in a slight protrusion of the contact after the injection is finished.

Cavity 620 is then injected with a specified material. According to the design specifications, the material may be slightly rubbery or somewhat flexible, and it may vary in colors and textures. Cross section 601 is the mold top and cross-section 602 is the mold bottom.

Figure 7 shows the resulting pad 720. The thickness of pad 720 matches the opening of the cavity 620 in Figure 6. Surfaces 410 a-n #1-n protrude on the top side, thus allowing for connection with feet of devices as discussed earlier.

Not shown, for reasons of simplicity and clarity, is the wiring that connects each section of spring steel insert to the controller and power supply of the device, as discussed in previous co-pending applications. Depending on the number of contact zones, multiple wires may be embedded in the mold, and the mold may have provisions for holding said wires in place during the injection process. In some cases the wiring may be done by having an extended steel frame, similar to the lead frame used in the manufacturing of integrated circuits, rather than attaching wires individually. All the wires carried by those extended lead frames could then terminate at one connector at the side of the finished pad, and could there be connected to a controller and/or a power supply, as described earlier.

Typically the spring metal sheets could be loaded into the mold either manually or automatically. They would then be secured in a certain position with pins such as 610 a-n. Those pins may have additional features, such a protruding smaller pin fitting into a hole in the spring sheet, to ensure absolute, precise positioning. Additional pins may be provided to hold wiring down while the plastic flows into the mold.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novel art of this disclosure.

The cost advantage of this design is that stamping the steel contacts should result in lower manufacturing costs.

Appendix J

Small Geometry Pads and System for Wireless Power Supply

Inventors Tal Dayan, Dan Kikinis, Ofer Goren, Pandurangan Ramakrishnan

MW 012

Background

Although the system described in previous co-pending provisional application titled "Enhanced Contact Systems For Surfaces And Devices" filed 09/25/2002, Attorney Docket No. 6041.P009z, application no. 60/413,791, of which this disclosure is related, is very useful, sometimes only certain aspects of its novel art are required in a low-end, limited-usage application. In particular, for very inexpensive, low-end devices, it may be wasteful to integrate a full system into the basic product.

What is clearly needed in such cases is a simplified, basic pad that allows the user to start with a low-cost minimum solution, but also allows system upgrades at a later time.

Description of the Embodiment

Figure 1 shows a mobile electronic device, such as a mobile telephone 110. It has two contact zones 111a and 111b, as described in the previous co-pending applications. Instead of a full pad with many zones, in this case the system has only a small pad 100 with only two contact zones, 121a and 121b. Power supply 123 may be a very basic power supply, or even the standard power supply of current art that is sold with the device 110. It may have only limited capabilities or even only capabilities to operate that one single device. In some cases, such a small pad can be integrated in a larger equipment such as car dashboard, furniture, treadmills, etc.

The user simply puts the phone 110 down onto pad 100, thus establishing an electrical circuit.

Figure 2 shows the phone 110 on pad 100. It is clearly visible that phone contacts 111a and 111b are aligned with pad contacts 121a and 121b. The angle omega 222 between device main axis and the pad main axis does not have to be exactly zero degrees. Omega 222 may be 10 degrees, 20 degrees, or even as great as 45 degrees. In some cases, it can also be rotated by 180 degrees in addition to the slight angles mentioned above.

In some cases, pad 100 may be bounded by a small frame (not shown) to limit the range of omega 222. That frame may have an opening to accommodate protruding features that are characteristics of the device, such as the antenna, so that placing the device in the frame with the protruding features in the corresponding opening would also restrict the omega 222, without, at the same time, requiring precise insertion, as would typically be required when a device such as phone 110 is inserted into a charging cradle (not shown) of the type used in current art.

Figure 3 shows another embodiment of the novel art of this disclosure. Phone 310 may have two or three contacts 311a, 311b, and, optionally, 311b . Circular pad 300 has a center contact zone 321a, an outer contact ring 321b, and a no-contact zone 321c, which lies between zones 321a and 321b. Pad 300 is connected by wire 322 to power supply 323 (may be the same as power supply 123), which in turn plugs in to main ac power source 324.

As shown in Figure 4, in most cases, the phone 310 may be casually set down onto pad 300. Due to the circular nature this embodiment, there is no limit to the omega 422 of alignment of the phone with the pad. Pad 300 may in some cases have a raised edge at its outer perimeter to force the phone into correct contact with the pad; however, there may be a gap of a few millimeters (a quarter-inch to a half-

inch) allowing convenient, sloppy application, rather than requiring precise positioning, as is generally required with insertion of a device into a power connector or cradle in current art.

In some cases, due to the small nature of these pads, a plastic clip-on or slip-on cover (not shown) may be used that has openings for the contact pads, allowing the user to customize the look and possibly the feel of the pad. Options could include different colors, flags, transparency, rubbery or fuzzy coatings, etc.

In some cases even additional lighting effects (not shown) may be offered, such as blue pulsing during charge, low-level blue when trickle charging, red flashing when mis-connected, etc. Alternatively, the light color could change to indicate the level of charge, much as some a fuel gauges indicate the fuel level, starting with red or orange ("empty") and thence progressing to yellow, green and finally blue (everything is "cool"). In some cases the lighting effects and other functions may be added by the user as a plug-in option into an existing, basic passive pad.

Further, many modifications and/or additions may be made without departing from the spirit of the invention. For example, in many cases, typically, a power supply may have a current limit or other protection mechanism, so the pad may be completely passive, to satisfy safety requirements.

Further, in some cases, because a device may have a dc/dc regulator able to accept a wide range of voltages, no issues would occur if there were no exact match. In yet other cases, devices may have a protection mechanism that would pass the power to the device only when the voltage and current are in range, as described earlier in previous applications. In yet other cases, a device may include an automatic polarity routing (e.g., active or passive rectifier bridge). The attached appendices A, B, C, D, E, F, G, H, and I are incorporated herein by reference.

APPENDIX A

Application for Provisional Patent

CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM

Inventors: Ofer Goren, Tal Dayan, and Elliott Stein

CROSS-REFERENCES TO RELATED APPLICATIONS: TBD

BACKGROUND & FIELD OF INVENTION:

Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

What is clearly needed is a better way to solve these problems by providing a power source that allows random placement and movement of the device without requiring plugging in a cable, cradle etc..

The field of the invention is that of power supplies and re-chargers interconnections for portable or mobile devices.

DESCRIPTION OF THE INVENTION:

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other as the "Adapter" but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the 'relative placement' or "Placement" in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS t The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

1. Contact A1 of the Base touches contact B1 of the Adapter;
2. Contact A2 of the Base touch contact B2 of the Adapter;
3. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the

proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

CLAIMS:

1. A system for improving the connection between a mobile device and a power charger unit, consisting of a two substantially planar surfaces, each of those surfaces containing at least two contacts, wherein for closing the electric circuit all that is required is to set on surface in contact with the other without accurate alignment.

2. A method for improving the connection between a mobile device and a power charger unit, consisting of a two substantially planar surfaces, each of those surfaces containing at least two contacts, wherein for closing the electric circuit all that is required is i) to set on surface in contact with the other without accurate alignment.

APPENDIX B

Application for Provisional Patent

AUTOMATIC AND ADAPTIVE POWER SUPPLY

Inventors: Ofer Goren, Tal Dayan, and Elliott Stein

CROSS-REFERENCES TO RELATED APPLICATIONS: Application No. 10/____ filed 03/01/2002 titled COUPLER WITH THREE DEGREES OF FREEDOM.

BACKGROUND FIELD OF INVENTION:

Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system.

What is clearly needed is a power supply control unit that controls the electrical power provided to contacts of a power supply system or a coupling system respectively.

The field of the invention is that of power supplies and re-chargers for portable and mobile devices.

Description of the preferred embodiment

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 1 shows

a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 2 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple mechanical or relay type switches, as indicated her for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts.

Fig. 3 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

CLAIMS:

1. A power provisioning system, having a power supply with two or more electrical contacts, further including in the power supply a sensing unit connected within the power supply and a control unit, also connected within the power supply, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the power supply, such that, when the of contacts of the load touch contacts of the power supply, the sensing unit senses that touching and instructs the control unit to provide power to some of the contacts of the Power Supply.

2. A method for power provisioning, having a power supply with two or more electrical contacts, further including in the power supply a sensing unit connected within the power supply and a control unit, also connected within the power supply, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the power supply, wherein, upon the of contacts of the load touch contacts of the power supply, i) the sensing unit senses that touching and ii) instructs the control unit to provide power to some of the contacts of the Power Supply.

APPENDIX C

Application for Provisional Patent

WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

Inventors: Tal Dayan, Ofer Goren, Elliott Stein, and Dan Kikinis

CROSS-REFERENCES TO RELATED APPLICATIONS: Application 10/_____ filed 03/01/2002 titled COUPLER WITH THREE DEGREES OF FREEDOM and application 10/______ filed 03/01/2002 titled AUTOMATIC AND ADAPTIVE POWER SUPPLY

BACKGROUND **FIELD OF INVENTION:**

Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM" describing a multi-contact coupling system and application titled "AN AUTOMATIC AND ADAPTIVE POWER SUPPLY" describing a multi contact smart power supply.

What is clearly needed is a better way to allow portable devices to be charged without requiring plugging in a cable, cradle etc. that would inhibit their use to some degree while charging.

The field of the invention is that of power supplies and re-chargers for portable and mobile devices.

Description of the preferred embodiment

Connecting

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces,

two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other as the "Adapter" but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the 'relative placement' or "Placement" in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as

projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS. The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

1. Contact A1 of the Base touches contact B1 of the Adapter;
2. Contact A2 of the Base touch contact B2 of the Adapter;
3. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the

contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. (only array shown) Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Powering

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 5 shows a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the

ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of Fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 6 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple mechanical or relay type switches, as indicated here for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination or any passive or active circuit, even inductors and capacitors can be used to convey presence and parameters to the base. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load or, in some cases, the adapter can have intelligence to disconnect the load until it establish a

connection or gets power from the base, this may be useful for example for resistive loads.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts. In some cases, the power base may disconnect on sense of the device current usage pattern.

Fig. 7 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device. It is clear to person skilled in the art, that rather than having a number of fixed voltage rails, for example two programmable rails may be used, and the parameters reported back from the ID device may help select the voltages.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

System

Combining the above-described elements into a complete system allows the user to have more freedom when using a notebook computer, for example, at a desk or similar prepared type of environment, such as a home office, a hotelling situation in a corporate environment, or even at a kiosk in an airport or other public place.

Figure 8 shows a desk 801 on which a desk mat 800 is placed. The desk mat is built according to the descriptions mentioned above. In the future, in some cases such a desk mat may be integrated into a part of the desk surface, rather than being a separate mat, but for the near future it will be easier to replace regular desk mats with these conductive types of desk mats.

Further, by using different techniques, the appearance may be changed dramatically. For example, a conductive plastic may be applied in a thin layer on top of a metallic conductor interleaved with non conductive material surrounding both the conductive plastic and metal. In other cases, metallic areas may be silk-screened with color, leaving sufficient openings for contact. In yet other cases, acidic etching into the metal may create openings to deposit colored resin, similar to anodizing of aluminum. In yet other cases, chrome-plated or nickel finished round metal spots may be embedded in a black rubber mat, for creative design. All these approaches can be used to make a desk mat product to be visually appealing to consumers, but essentially do not diverge from the invention disclosed here.

Cabling system 803 is hidden away behind the desk through an opening and connects to a power supply unit 802 that contains both the power source itself and the sensing and switching capability as described above. Power cord 804 with power connector 805 plugs into a regular household ac outlet, of the type available in normal homes and offices.

Figure 9 shows one case, in which the Adaptor Piece as attached to a notebook 900. The notebook is shown from the lower rear, with a view of notebook base 902 and notebook lid 901, which is slightly open. Adaptor piece 910 is attached to the bottom of the notebook using, for example, hook-and-pile fastener or mounting tape, or any other suitable fastening method, including but not limited to screws, bolts, glue, cement, snaps etc. Adaptor piece 910 has, in this example, three separate areas 911, 912, and 913, wherein areas 911 and 913 may be conductive surfaces and area 912 is an insulator. Cable 920 plugs into the regular power supply of the notebook. Also shown is a wireless Ethernet card 930 protruding from the PCMCIA slot, a typical situation with notebook

computers. In some cases, the adaptor may be an integral part of the notebook's enclosure, or in some cases more specifically also integrated with the battery or its enclosure, hence not requiring a special cable, or an attachment. Also, in case of a cable mentioned above, a convenience receptacle may be offered, so the user does not have to unplug the adapter piece in case of using a regular charger w/base. In some of these cases, the adapter may be electrically disconnected, as to avoid hazards by exposing hot contacts.

Figure 10 shows an overview of the notebook 900 placed freely on the desk 801 of Figure 8, as an example of a system setup. Notebook 900 is depicted as placed at an odd angle, to exemplify that such a device may, according to the novel art of this disclosure, be placed in any kind of position in this example on mat 800, allowing for the system to charge while the notebook is in use, without having to plug in any cables or carry any power supplies.

Many variations may be made to the system as presented herein without departing from the spirit of the novel art of this disclosure.

Contacts 911,912 & 913 of adaptor piece 910 may be round rather that square; its dimensions may match those of the notebook base, rather than being scaled to a functional minimal size, following the rules proposed earlier; adaptor piece 910 may connect to a docking connector available on the bottom of some notebooks, rather than to the power cord. Or, in a preferred mode, adaptor piece 910 may be integrated into the standard enclosure of a notebook, eliminating the need for a separate, add-on device.

Desk mat 800 may also have many variations. It may be used in conjunction with a standard power supply provided by the notebook manufacturer and contain by itself only the sensing and switching functionality, rather than the full power supply.

In yet other cases, the system may also be used to transmit data over the established electrical connections, rather than just power. That may be achieved by either using additional contacts, as is proposed earlier, or by modulating the signal(s) onto the existing power leads, and adding a filter (i.e. inductor/cap) to separate the dc supply and the high

peed data signals, such as Ethernet etc. In such cases, an Ethernet port may be offered on both the desk mat 800 (not shown) and a cable on adapter piece 910 (not shown). Other network standards besides Ethernet may also be supported, as desired or required by the market, both current and future ones. In some cases yet, wireless methods may be used for the data, such as optical including InfraRed (IR), inductive coupling, capacitive coupling, or radio frequency with or without some modulation techniques. That may include virtual docking connections or regular Local Area Network connections or both.

Many variations may be formed by shifting the partitioning or integration of features among various elements. In some cases, for example, the mat may be integrated into the desk; in other cases, it may be a foldable or rollable mat, reduced in size for easy portability, for the convenience of travelers. Further, in some cases input devices may be integrated in the base (e.g. a tablet or a large touch pad), the pad surface may be extra mouse friendly (both for mechanical and optical mice), or it may also be used to powering semi-mobile devices such as desk lamp or electric stapler etc. Additionally, there are advantages to ensure that the pad is an anti static pad (making it even safer than using no pad at all), or some of these extensions may be offered as modules, including making the pad area modular (cut to order, tiles, etc). In some cases, the base provides a standard power and each device/adapter converts it to the level needed by its respective device. Also, in some cases some information and sensing is done in the reversed direction (base to device) and the device also makes some decisions or power switching (e.g. is that base safe for me).

Many other configurations and variations are also possible that do not depart from the spirit of the invention.

CLAIMS:

1. A mobile device power delivery system, having a power supply with two or more electrical contacts, further a sensing unit connected to the power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, such that, when the of contacts of the load touch contacts of the base unit, the sensing unit senses that touching and instructs the control unit to provide power to some of the contacts of the base unit.

2. A method for power delivery to a mobile device, having a power supply with two or more electrical contacts, further a sensing unit connected to the power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, wherein, i) upon touching of contacts of the load to contacts of the base unit, ii) the sensing unit senses that touching and instructs the control unit to provide power to some of the contacts of the base unit.

APPENDIX D

Application for Provisional Patent

TITLE:
ENHANCED WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

Inventors Tal Dayan
Andy Goren
Dan Kikinis
Bill Maggs

CROSS-REFERENCES TO RELATED APPLICATIONS:

COUPLER WITH THREE DEGREES OF FREEDOM
AN AUTOMATIC AND ADAPTIVE POWER SUPPLY
WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

BACKGROUND FIELD OF INVENTION: Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system and application titled "AN AUTOMATIC AND ADAPTIVE POWER SUPPLY" describing a multi contact smart power supply.

What is clearly needed, is a better way to allow portable devices to be charged, without requiring plugging in a cable, cradle etc.. that would inhibit their use to some degree while charging.

In some cases, even some of the ways to charge portable devices as described above may have some practical shortcomings. For example, in cases known to the inventors there is a requirement that each conductive section be turned on or off, and the number of sections, in actual practice, is often limited, due to the relatively high cost of switching the sections actively on or off.

For example, even though the technology known to the inventors covers a situation where you would have a thousand sections with a fine resolution, allowing the use of small devices such as key chains, cell phones, ear pieces, etc., which increasingly are smaller and smaller, the cost of such a system, with today's component costs, might be too high to be practical.

What is clearly needed is an alternative approach that allows delivery of the same functionality in a smaller geometry space, without increasing the cost of the switches (too many) to a point where the system becomes infeasible or too expensive to use.

Description of the preferred embodiment

Connecting

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the

conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other as the "Adapter" but this choice of wording is arbitrary and does not imply any preferred embodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their relative position can be expressed as a tuple of three numbers <X, Y, G> called the 'relative placement' or "Placement" in short. The X and Y values denote the linear displacement between the centers of the two surfaces in the X and Y axis respectively. The G value denotes the relative radial angle in degrees between the two surfaces as projected on the X,Y plane with some arbitrary relative rotation considered to be of zero degrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present invention if a closed electrical circuit can be formed between the Base and the Adapter through the contacts of the Base and the Adapter. In a preferred embodiment, the set of active Placement forms a continuous range without gaps but this characteristic depends on the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS. The Base and the Adapter surfaces each has at least two contacts whose count, sizes, shapes and spacing and arrangement are determined such that in each Placement that is the active range of the coupler, there is at least one pair of contacts A1 and A2 of the Base and at least one pair of contacts B1 and B2 of the Adapter such that

1. Contact A1 of the Base touches contact B1 of the Adapter;
2. Contact A2 of the Base touch contact B2 of the Adapter;
3. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. (only array shown) Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Powering

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts, a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment, the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status,

identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage. and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 5 shows a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status, Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 6 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used, rather than simple mechanical or relay type switches, as indicated here for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in any combination or any passive or active circuit, even inductors and capacitors can be used to convey presence and parameters to the base. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load or, in some cases, the adapter can have intelligence to disconnect the load until it establish a connection or gets power from the base, this may be useful for example for resistive loads.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit,

hereby disconnecting the power from the contacts. In some cases, the power base may disconnect on sense of the device current usage pattern.

Fig. 7 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device. It is clear to person skilled in the art, that rather than having a number of fixed voltage rails, for example two programmable rails may be used, and the parameters reported back from the ID device may help select the voltages.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

System

Combining the above-described elements into a complete system allows the user to have more freedom when using a notebook computer, for example, at a desk or similar

prepared type of environment, such as a home office, a hotelling situation in a corporate environment, or even at a kiosk in an airport or other public place.

Figure 8 shows a desk 801 on which a desk mat 800 is placed. The desk mat is built according to the descriptions mentioned above. In the future, in some cases such a desk mat may be integrated into a part of the desk surface, rather than being a separate mat, but for the near future it will be easier to replace regular desk mats with these conductive types of desk mats.

Further, by using different techniques, the appearance may be changed dramatically. For example, a conductive plastic may be applied in a thin layer on top of a metallic conductor interleaved with non conductive material surrounding both the conductive plastic and metal. In other cases, metallic areas may be silk-screened with color, leaving sufficient openings for contact. In yet other cases, acidic etching into the metal may create openings to deposit colored resin, similar to anodizing of aluminum. In yet other cases, chrome-plated or nickel finished round metal spots may be embedded in a black rubber mat, for creative design. All these approaches can be used to make a desk mat product to be visually appealing to consumers, but essentially do not diverge from the invention disclosed here.

Cabling system 803 is hidden away behind the desk through an opening and connects to a power supply unit 802 that contains both the power source itself and the sensing and switching capability as described above. Power cord 804 with power connector 805 plugs into a regular household ac outlet, of the type available in normal homes and offices.

Figure 9 shows one case, in which the Adaptor Piece as attached to a notebook 900. The notebook is shown from the lower rear, with a view of notebook base 902 and notebook lid 901, which is slightly open. Adaptor piece 910 is attached to the bottom of the notebook using, for example, hook-and-pile fastener or mounting tape, or any other suitable fastening method, including but not limited to screws, bolts, glue, cement, snaps etc.. Adaptor piece 910 has, in this example, three separate areas 911, 912, and 913, wherein areas 911 and 913 may be conductive surfaces and area 912 is an insulator.

Cable 920 plugs into the regular power supply of the notebook. Also shown is a wireless Ethernet card 930 protruding from the PCMCIA slot, a typical situation with notebook computers. In some cases, the adaptor may be an integral part of the notebook's enclosure, or in some cases more specifically also integrated with the battery or its enclosure, hence not requiring a special cable, or an attachment. Also, in case of a cable mentioned above, a convenience receptacle may be offered, so the user does not have to unplug the adapter piece in case of using a regular charger w/base. In some of these cases, the adapter may be electrically disconnected, as to avoid hazards by exposing hot contacts.

Figure 10 shows an overview of the notebook 900 placed freely on the desk 801 of Figure 8, as an example of a system setup. Notebook 900 is depicted as placed at an odd angle, to exemplify that such a device may, according to the novel art of this disclosure, be placed in any kind of position in this example on mat 800, allowing for the system to charge while the notebook is in use, without having to plug in any cables or carry any power supplies.

Many variations may be made to the system as presented herein without departing from the spirit of the novel art of this disclosure.

Contacts 911,912 & 913 of adaptor piece 910 may be round rather that square; its dimensions may match those of the notebook base, rather than being scaled to a functional minimal size, following the rules proposed earlier; adaptor piece 910 may connect to a docking connector available on the bottom of some notebooks, rather than to the power cord. Or, in a preferred mode, adaptor piece 910 may be integrated into the standard enclosure of a notebook, eliminating the need for a separate, add-on device.

Desk mat 800 may also have many variations. It may be used in conjunction with a standard power supply provided by the notebook manufacturer and contain by itself only the sensing and switching functionality, rather than the full power supply.

In yet other cases, the system may also be used to transmit data over the established electrical connections, rather than just power. That may be achieved by either using

additional contacts, as is proposed earlier, or by modulating the signal(s) onto the existing power leads, and adding a filter (i.e. inductor/cap) to separate the dc supply and the high speed data signals, such as Ethernet etc. In such cases, an Ethernet port may be offered on both the desk mat 800 (not shown) and a cable on adapter piece 910 (not shown). Other network standards besides Ethernet may also be supported, as desired or required by the market, both current and future ones. In some cases yet, wireless methods may be used for the data, such as optical including InfraRed (IR), inductive coupling, capacitive coupling, or radio frequency with or without some modulation techniques. That may include virtual docking connections or regular Local Area Network connections or both.

Many variations may be formed by shifting the partitioning or integration of features among various elements. In some cases, for example, the mat may be integrated into the desk; in other cases, it may be a foldable or rollable mat, reduced in size for easy portability, for the convenience of travelers. Further, in some cases input devices may be integrated in the base (e.g. a tablet or a large touch pad), the pad surface may be extra mouse friendly (both for mechanical and optical mice), or it may also be used to powering semi-mobile devices such as desk lamp or electric stapler etc. Additionally, there are advantages to ensure that the pad is an anti static pad (making it even safer than using no pad at all), or some of these extensions may be offered as modules, including making the pad area modular (cut to order, tiles, etc). In some cases, the base provides a standard power and each device/adapter converts it to the level needed by its respective device. Also, in some cases some information and sensing is done in the reversed direction (base to device) and the device also makes some decisions or power switching (e.g. is that base safe for me).

Many other configurations and variations are also possible that do not depart from the spirit of the invention.

Small Geometry Solutions

Figure 11 shows a track system of interleaved plus and minus tracks. The plus tracks are numbered 1100 a, b, and c, and the minus tracks are numbered 1110 a and b. These tracks each have protrusions, similar nails or bolts, rising from the tracks themselves,

numbered, respectively, 1102x and 1112x, and they are interleaved. These tracks could be embedded in an injected plastic or engraved wood surface, forming the pad 1101 shown here as a semivisible thickness aspect.

Figure 12 shows a top view. Again, a section of pad 1101 is shown. In this view, only three tracks are shown, creating an interleaving pattern of those rising conductor sections 1102x and 1112x, offset by half a grid from each other. The dots represent that those rising conductors (feeding points FPs) extend in both directions to whatever size is required.

Figure 13 emphasizes the interesting aspect of such a system as system 1200. Again, the FPs 1102 a-d are shown marked with a plus, and the dots 1112 a-c are shown with minus. FPs 1102 g-j are shown with plus; FPs 1112 g-i are shown with minuses.

Overlaying, in a transparent manner, is a contact pad 1300, containing three contacts. Each contact 1301, 1302, and 1303 is separate from each other contact, and may be used to feed a selection logic that determines which contact has been connected to a plus and which to a minus. In reality, a higher number of contacts such as 5 or more may be required to guarantee at least one contact to a plus FP and one contact to a minus FP, depending both on the geometry of the pad and the contact pad, as well as the contacts and FPs. For better clarity of the diagram however, only 3 are shown (in fact using this geometrical arrangement, it is easy to provide mathematical proof that even 4 contacts do not guarantee always one plus and one minus). The words Plus and minus are to be seen in the broadest terms simply representing to conduits for power, since in some cases, rather than DC, AC may be used, or pulses, or power in conjunction with data etc.

The easiest way to achieve correct connectivity is to use a bridge rectifier to extract the voltage from the FPs and then use that voltage to drive the circuitry (not shown) between contact pad 1300 and a device (not shown), such as a notebook. The circuitry then, using low drop switches (i.e., bipolar solid state switches in parallel to the bridge rectifier), connects the actual contacts of contact pad1300 to the conductors of the notebook charger connector (details not shown).

It is clear that depending on the structure of the protrusions out of the plane (not shown) of the FPs and their sizes and distances between themselves, the contact pads and their contacts must be such that they cannot short between plus and minus FPs, on one hand; and that independent of the positioning on the surface, always at least one plus and one minus are connected.

In yet other situations, a complete rail may surface and depending on the dimensions and distances, the dimensions and distances as well as the geometry of the contact pad 1300 may change. In some situations, a linear array may be better or a T-shape or X-shape, or a honeycomb-cluster-of-contacts, or other suitable multi-port connection may be preferred or required over a basic kind of contact pad. A very suitable candidate seems to be a diamond-shaped contact pad, using four rather than just three contacts in conjunction with an interleaving field of round FPs as shown in Figure 13.

Depending on their sizes and geometry (for example, the FPs may be formed into diamond shapes, covering almost all of the surface with very tiny gaps for insulation, or a honeycomb pattern may be used, or just round dots as shown in Figure 13, or any other type of suitable geometry, and they may have protrusions, for example spherical, cylindrical with or without mitering, pokes etc), more than three or four contacts may be required to guarantee contact to a pair of FPs with opposite polarity to a pair of contacts on the contact pad, with shorting any FPs. A suggested approach to evaluating suitable geometries is model their connectivity by either a computer simulation or a mathematical formula. In many cases, the design of the Fps on the pad will be driven by Industrial Design, and will necessitate all the other dependencies to follow suit.So many different variations are possible that stay within the scope of the invention that it is impossible even to list all the examples, but essentially they all end up doing the same. In some cases, it may be preferable to arrange the contact pad across the whole geometry of the portable device, rather than across only a localized group, thus allowing the weight to distribute across all contacts, ensuring a better electrical contact, rather than having all contacts of the contact pad in one corner, which might lift some of them off, unless they are spring loaded or the pad is pivotally mounted. In some other cases, the contacts may be integrated again in the enclosure of the portable device itself, with internal

connections. In some cases, power may be always on to such a pad, and no sensing may be done at all, or only basic short circuit protection may be provided.

Figure 14 shows another example of a pad 1101 whose microstructure has been sectioned into sections 1401 a-n. For example, the plus of each section could be connected separately through a cable 1410 to adaptive power supply 1420, and the minus throughout the whole pad can stay connected so it is always on.

In such an example, once a device is deposited, only that section containing the device may be activated. Thus different sections of the pad could have different voltages, allowing the device not to require a regulator on the adaptor piece. So a user could then place a cell phone, laptop computer, and PDA all onto surface 1101, and the adaptive power supply would, after identifying each device, turn on either a standard voltage or a voltage specific to each device, depending on whether the devices have voltage adaptors themselves or have only identification switching devices.

Sample CLAIM:

Claim 1: A mobile device power delivery system, having a power supply with two or more electrical contacts in an interleaving arrangement, further a power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, such that, when the of contacts of the load touch contacts of the base unit, the electrical circuit is closed.

Claim 2: A method for power delivery to a mobile device, having a power supply with two or more electrical contacts in an interleaving arrangement, further a power supply and a control unit, also connected to the power supply, and also connected to a base unit with two or more contacts, and a load, with two or more electrical contacts and an identification element, connecting to the electrical contacts of the base unit, wherein, i) upon touching of contacts of the load to contacts of the base unit, ii) the electrical circuit is closed.

APPENDIX E

Application for Provisional Patent

TITLE:
ENHANCED WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

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CROSS-REFERENCES TO RELATED APPLICATIONS:

COUPLER WITH THREE DEGREES OF FREEDOM
AN AUTOMATIC AND ADAPTIVE POWER SUPPLY
WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM FOR SMALL DEVICES

BACKGROUND FIELD OF INVENTION: Currently, a variety of mobile and portable devices, including laptop and portable computers, mobile telephones, pagers, personal digital assistants and other electronic devices must be connected to external electrical power sources that provide electrical power to the devices themselves, or, to recharge internal batteries of such devices, namely re-chargers. Access to these power sources, typically a plug-in cable, restrict the locations and mobility of such devices.

Known to the inventor is copending application titled "CONDUCTIVE COUPLER WITH THREE DEGREES OF FREEDOM " describing a multi-contact coupling system and application titled "AN AUTOMATIC AND ADAPTIVE POWER SUPPLY" describing a multi contact smart power supply.

What is clearly needed, is a better way to allow portable devices to be charged, without requiring plugging in a cable, cradle etc.. that would inhibit their use to some degree while charging.

In some cases, even some of the ways to charge portable devices as described above may have some practical shortcomings. For example, in cases known to the inventors there is a requirement that each conductive section be turned on or off, and the number of sections, in actual practice, is often limited. due to the relatively high cost of switching the sections actively on or off.

For example, even though the technology known to the inventors covers a situation where you could have a thousand sections with a fine resolution, allowing the use of small devices such as key chains, cell phones, ear pieces, etc., which increasingly are smaller and smaller, the cost of such a system. with today's component costs, might be too high for mass consumers.

What is clearly needed is an alternative approach that allows delivery of the same functionality in a smaller geometry space, without increasing the cost of the switches (too many) to a point where the system becomes too expensive.

<<CIP ADDITION MW p5>>

Further to the options discussed above, there are new ways and means of implementing essentially the same novel art with nonconductive surfaces. What is clearly needed are an apparatus and a method that allow the implementation of the above-described goal, using nonconductive surfaces, or additional enhancements for easier control, better performance, etc., when using conductive surfaces.

Description of the preferred embodiment

Connecting

The invention describes an electrical coupling system ("CS") that allows the closing of an electrical circuit between two bodies, each with a surface that contains an electrical conductive area. The CS provides three degrees of freedom between the two surfaces, two as a linear movement or offset in the X and Y axis of a plane essentially co-planar to the larger of the bodies, and the third is a rotation around the Z axis perpendicular to that plane. Figure 1 shows a simplified isometric view of a CS consisting out of the conductive are marked "BASE" in the base unit, that is typically stationary, and a second conductive area marked "Adapter". Also shown for orientation is the above mentioned coordinate system, and wires marked "wires (adapter side)" and "wires (base side)" respectively. Those conductive areas may either be attached to the bodies, or in a preferably integrated into the body structure. This allows a circuit to be closed, with out requiring alignment, as is typically required by connectors, cradles etc.

In one instance, the Coupler may be used to power a laptop computers or other Devices that are placed freely on an energizing desktop or other surface forming the base. The desk or surface acts as one side of the coupler and the bottom of the Device acts as the second side. A power supply is connected to the active part of the desk or surface (such as a desk pad, writing pad etc.) and can close an electrical circuit with the active area of the device placed upon, allowing a charging circuit of the Device independent of the position and orientation or angle of the Device.

The CS is made of two surfaces, and each of the surfaces having at least two contacts. For convenience the stationary surface will be referred to as the "Base" and to the other

s the "Adapter" but this choice of wording is arbitrary and does not imply any preferred mbodiment or limit the possible embodiments of the present invention.

When the two surfaces are put together (typically the adapter on top of the base, their elative position can be expressed as a tuple of three numbers <X, Y, G> called the relative placement' or "Placement" in short. The X and Y values denote the linear lisplacement between the centers of the two surfaces in the X and Y axis respectively. 'he G value denotes the relative radial angle in degrees between the two surfaces as rojected on the X,Y plane with some arbitrary relative rotation considered to be of zero legrees.

A Placement is said to be 'supported' or 'active' by an embodiment of the present nvention if a closed electrical circuit can be formed between the Base and the Adapter hrough the contacts of the Base and the Adapter. In a preferred embodiment, the set of ctive Placement forms a continuous range without gaps but this characteristic depends n the application in which each embodiment is used.

Fig. 2 shows a simplified view of an adapter placed on a base, forming a CS. The 3ase and the Adapter surfaces each has at least two contacts whose count, sizes, shapes nd spacing and arrangement are determined such that in each Placement that is the ctive range of the coupler, there is at least one pair of contacts A1 and A2 of the Base nd at least one pair of contacts B1 and B2 of the Adapter such that

1. Contact A1 of the Base touches contact B1 of the Adapter;
2. Contact A2 of the Base touch contact B2 of the Adapter;
3. The contacts of the Base and the Adapter do not form a short circuit between A1 and A2.

A careful review of these conditions shows that when these conditions are met, a two-wire electric circuit can be formed between the Base and the Adapter using contacts A1-B1 as one lead and contacts A2-B2 and the other lead.

The routing of the current to the proper pair of contacts for each Placement can be done in many ways. In some embodiment, a sensing circuit detect a signal that is asserted by the Adapters to the Base contacts it touches and use this information to activate that Base contacts. In other embodiment the current can be redirected to the proper contacts by sensing the relative position of the two surfaces and using a predefined formula to determine which Base contacts to activate. In other embodiment, the Base can switch the power to a sequence of pairs of Base contacts until it senses the proper circuit is closed with the device. In other embodiment, the current routing can be done by mechanical switches that are activated by the surfaces based on their relative location. In yet other cases a spacing pattern can be selected, by which due to the distance of the contacts on the adapter and on the base, always a correct correlation can be guaranteed, by using a checker board style pattern for the base, e.g. Fig. 2. (only array shown) Also shows a "power source" connected to the base, without showing the above mentioned switching mechanisms for simplicity.

Other options are discussed later in this disclosure.

Fig. 3 shows an example of how a CS for a notebook might be implemented.

In this case the Coupler provides a wide range of movement in the X and Y directions and a 360 degrees freedom of rotation around the Z axis. The Base is the top surface of a desktop, the Adaptor is built in into a notebook, and the Adapter contacts are mounted on the bottom surface of notebook. They could be built in some cases, or an actual adapter pad with contact areas may be attached to the bottom side of a regular notebook and a wire may connect the notebook's regular charging port. The Base contacts in this

embodiment are arranged as an array of circle of radius R with horizontal and vertical spacing of D between any two adjacent contacts.

Other options are discussed later in this disclosure.

The Adapter in this example uses only two contacts, each is a circle of radius (R+D/2)*SQRT(2) and with a spacing of at least 2R.

A close examination of the design shows that in this embodiment, when the notebook is placed on the desktop at an arbitrary location and angle, two Base contacts A1 and A2 that satisfy the three conditions above can always be found. These two contacts can be used to close a circuit with the notebook through the two notebook contacts. It is clear that other spacing and contact sizes and placements may be used. For example, rather than just rows and columns, the base may have a honey-comb style interleaving arrangement, or long linear contacts etc.

Again, for help of understanding a "load" symbolizes the electric aspects of the notebook, and the "power source" that of a supply, which may be in some cases considerably more complex.

Powering

Figure 4 shows an example, in which the CS is simplified by eliminating the need to perform dynamic power switching to the Base contacts at the expense of providing a more limited active range of positions and rotational angles. The Base uses two large rectangular pads and the Base use two smaller round pads. This arrangement allows

limited linear movement in the X and Y axis and limited rotational movement around the Z axis.

In order to control power application to a multi-contact coupling system, preferably in the idle state, the contacts of the power supply are not energized. When a load is connected to the power contacts. a sensing unit in the power supply detects that load and switches the power to the contacts based on information and properties of the load. In one embodiment. the power is of a pre-defined voltage and polarity or frequency is engaged. In some cases, the power supply may sense various parameters such as operational status, identification, and power requirements from the load and perform authentication, authorization and compatibility checks and then provide power to appropriate contacts using the required voltage and polarity. In yet other cases, the power supply may be a surface with a plurality of exposed contacts and may power multiple loads, each connected to another set of contacts and each having a different voltage or character. In some cases, the apparatus will provide protection against short circuits and overloads when contacts of the power supply are connected and provide personal shock protection when touching exposed contacts when a valid load is not present. Fig 5 shows a simplified diagrammatical overview of such a system. The power supply unit receives typically power from a standard household current supply, but in some cases may also use other sources, such as generators, solar panels, batteries, fuel cells, each separately or in any combination. On the other side, a multitude of contacts are shown as known to the inventor to exist in a Coupling System (CS). In the current art, the contacts of a power supply provide voltage in a preset voltage, frequency and polarity, independent on the actual load attached to it. In the present invention, the power supply detects when, where and how the load is connected to the power contacts, and may sense information such as identification, product type, manufacture, polarity power requirements, and other parameters and properties of the load and the connection, and uses this information to connect the power to the powered device thus, yielding several new benefits such as the

ability to perform authentication and compatibility checks before providing the power, adapting the voltage and polarity to the needs of the specific load, improving safety by avoiding exposed power connectors when no load is attached and the ability to power plurality of loads at the same time, each connected to an arbitrary set of contacts and receives a different voltage. This exchange or negotiation is symbolized by the arrows at the bottom of fig 1. labeled "ID, Status. Info" for the information provided by the device, and "power" for the resulting power applied to the correct set of contacts of the CS.

Fig. 6 shows a simplified overview, where for simplicity only the connected pair of the multitude is shown. It is clear to the artisan in the field, that more contacts can be managed, by first scanning for the presence of a device using more switches, and that those may be combined or may be separate from the polarity and voltage switches. Further advanced semi-conductors may be used. rather than simple mechanical or relay type switches, as indicated here for simplicity. The voltage and the polarity of the voltage are adjusted automatically to match the needs of the load.

When the two contacts of the load are connected to the two contacts of the power supply respectively, the sensing unit of the power supply detects the unique identifier of the unit ("ID") of the load through the connections and uses this ID to determine the voltage and current requirements of the load and the polarity in which it is to be connected. If the voltage and the current requirements are in the range supported by the power supply, the sensing unit sends a signal to the switch unit to power source in the right polarity and sends a signal to the power source to set the required voltage. This sensing is done by applying a minimal, non destructive sensing voltage or pattern, and observing responses of the ID element. That ID element may be as simple as a resistor, being read with a very low voltage below the activation of the normally non-linear response of the device load. In some cases it may be a diode, or a resistor and a diode in

any combination or any passive or active circuit, even inductors and capacitors can be used to convey presence and parameters to the base. In yet other cases, a digital ID may be used, and read, with a voltage that is below the active region of the load or, in some cases, the adapter can have intelligence to disconnect the load until it establish a connection or gets power from the base, this may be useful for example for resistive loads.

When the load is disconnected from the contacts, the sensing unit detects that the device bearing the ID is not connected to the power supply and turns off the switch unit, thereby disconnecting the power from the contacts. In some cases, the power base may disconnect on sense of the device current usage pattern.

Fig. 7 shows now a simplified system with multiple contacts, as shortly discussed above. It can provide power in two predefined voltage levels (V1, V2), and can power multiple devices in arbitrary combination of the two voltages requirements while automatically adapting the power polarity for each device. It is clear to person skilled in the art, that rather than having a number of fixed voltage rails, for example two programmable rails may be used, and the parameters reported back from the ID device may help select the voltages.

The power supply contains two power sources, one of voltage V1 and one of voltage V2. When the sensing unit detects that identification unit id1 is connected between power contacts C1(+) and C3(-) and activate the switches of contacts C1 and C2 to connect C1 to the (+) side of power source V1 and connect C2 to the (-) side of power source V1. In a similar way, the load L2 is connected to the voltage source V2 in the correct polarity through power contacts C2 and C6.

The sensing unit will typically be using a micro controller and some adaptation circuitry, including resistors, diodes, capacitors and possibly active components as well. Also, not shown are the supply to the sensing unit itself. As mentioned above, the control switches may be solid state or relays etc.

System

Combining the above-described elements into a complete system allows the user to have more freedom when using a notebook computer, for example, at a desk or similar prepared type of environment, such as a home office, a hotelling situation in a corporate environment, or even at a kiosk in an airport or other public place.

Figure 8 shows a desk 801 on which a desk mat 800 is placed. The desk mat is built according to the descriptions mentioned above. In the future, in some cases such a desk mat may be integrated into a part of the desk surface, rather than being a separate mat, but for the near future it will be easier to replace regular desk mats with these conductive types of desk mats.

Further, by using different techniques, the appearance may be changed dramatically. For example, a conductive plastic may be applied in a thin layer on top of a metallic conductor interleaved with non conductive material surrounding both the conductive plastic and metal. In other cases, metallic areas may be silk-screened with color, leaving sufficient openings for contact. In yet other cases, acidic etching into the metal may create openings to deposit colored resin, similar to anodizing of aluminum. In yet other cases, chrome-plated or nickel finished round metal spots may be embedded in a black rubber mat, for creative design. All these approaches can be used to make a desk mat product to be visually appealing to consumers, but essentially do not diverge from the invention disclosed here.

Cabling system 803 is hidden away behind the desk through an opening and connects to a power supply unit 802 that contains both the power source itself and the sensing and switching capability as described above. Power cord 804 with power connector 805

plugs into a regular household ac outlet, of the type available in normal homes and offices.

Figure 9 shows one case, in which the Adaptor Piece as attached to a notebook 900. The notebook is shown from the lower rear, with a view of notebook base 902 and notebook lid 901, which is slightly open. Adaptor piece 910 is attached to the bottom of the notebook using, for example, hook-and-pile fastener or mounting tape, or any other suitable fastening method, including but not limited to screws, bolts, glue, cement, snaps etc.. Adaptor piece 910 has, in this example, three separate areas 911, 912, and 913, wherein areas 911 and 913 may be conductive surfaces and area 912 is an insulator. Cable 920 plugs into the regular power supply of the notebook. Also shown is a wireless Ethernet card 930 protruding from the PCMCIA slot, a typical situation with notebook computers. In some cases, the adaptor may be an integral part of the notebook's enclosure, or in some cases more specifically also integrated with the battery or its enclosure, hence not requiring a special cable, or an attachment. Also, in case of a cable mentioned above, a convenience receptacle may be offered, so the user does not have to unplug the adapter piece in case of using a regular charger w/base. In some of these cases. the adapter may be electrically disconnected, as to avoid hazards by exposing hot contacts.

Figure 10 shows an overview of the notebook 900 placed freely on the desk 801 of Figure 8, as an example of a system setup. Notebook 900 is depicted as placed at an odd angle, to exemplify that such a device may, according to the novel art of this disclosure, be placed in any kind of position in this example on mat 800, allowing for the system to charge while the notebook is in use, without having to plug in any cables or carry any power supplies.

Many variations may be made to the system as presented herein without departing from the spirit of the novel art of this disclosure.

Contacts 911,912 & 913 of adaptor piece 910 may be round rather that square; its dimensions may match those of the notebook base, rather than being scaled to a functional minimal size, following the rules proposed earlier; adaptor piece 910 may

connect to a docking connector available on the bottom of some notebooks, rather than to the power cord. Or, in a preferred mode, adaptor piece 910 may be integrated into the standard enclosure of a notebook, eliminating the need for a separate, add-on device.

Desk mat 800 may also have many variations. It may be used in conjunction with a standard power supply provided by the notebook manufacturer and contain by itself only the sensing and switching functionality, rather than the full power supply.

In yet other cases, the system may also be used to transmit data over the established electrical connections, rather than just power. That may be achieved by either using additional contacts, as is proposed earlier, or by modulating the signal(s) onto the existing power leads, and adding a filter (i.e. inductor/cap) to separate the dc supply and the high speed data signals, such as Ethernet etc. In such cases, an Ethernet port may be offered on both the desk mat 800 (not shown) and a cable on adapter piece 910 (not shown). Other network standards besides Ethernet may also be supported, as desired or required by the market, both current and future ones. In some cases yet, wireless methods may be used for the data, such as optical including InfraRed (IR), inductive coupling, capacitive coupling, or radio frequency with or without some modulation techniques. That may include virtual docking connections or regular Local Area Network connections or both.

Many variations may be formed by shifting the partitioning or integration of features among various elements. In some cases, for example, the mat may be integrated into the desk; in other cases, it may be a foldable or rollable mat, reduced in size for easy portability, for the convenience of travelers. Further, in some cases input devices may be integrated in the base (e.g. a tablet or a large touch pad), the pad surface may be extra mouse friendly (both for mechanical and optical mice), or it may also be used to powering semi-mobile devices such as desk lamp or electric stapler etc. Additionally, there are advantages to ensure that the pad is an anti static pad (making it even safer than using no pad at all); or some of these extensions may be offered as modules, including making the pad area modular (cut to order. tiles, etc). In some cases, the base provides a standard power and each device/adapter converts it to the level needed by its respective device. Also, in some cases some information and sensing is done in the reversed

direction (base to device) and the device also makes some decisions or power switching (e.g. is that base safe for me).

Many other configurations and variations are also possible that do not depart from the spirit of the invention.

Small Geometry Solutions

Figure 11 shows a track system of interleaved plus and minus tracks. The plus tracks are numbered 1100 a, b, and c, and the minus tracks are numbered 1110 a and b. These tracks each have protrusions, similar nails or bolts, rising from the tracks themselves, numbered, respectively, 1102x and 1112x, and they are interleaved. These tracks could be embedded in an injected plastic or engraved wood surface, forming the pad 1101 shown here as a semivisible thickness aspect.

Figure 12 shows a top view. Again, a section of pad 1101 is shown. In this view, only three tracks are shown, creating an interleaving pattern of those rising conductor sections 1102x and 1112x, offset by half a grid from each other. The dots represent that those rising conductors (feeding points FPs) extend in both directions to whatever size is required.

Figure 13 emphasizes the interesting aspect of such a system as system 1200. Again, the FPs 1102 a-d are shown marked with a plus, and the dots 1112 a-c are shown with minus. FPs 1102 g-j are shown with plus; FPs 1112 g-i are shown with minuses.

Overlaying, in a transparent manner, is a contact pad 1300, containing three contacts. Each contact 1301, 1302, and 1303 is separate from each other contact, and may be used to feed a selection logic that determines which contact has been connected to a plus and which to a minus. In reality, a higher number of contacts such as 5 or more may be required to guarantee at least one contact to a plus FP and one contact to a minus FP, depending both on the geometry of the pad and the contact pad, as well as the contacts and FPs. For better clarity of the diagram however, only 3 are shown (in fact using this geometrical arrangement, it is easy to provide mathematical proof that even 4 contacts do not guarantee always one plus and one minus). The words Plus and minus are to be seen

in the broadest terms simply representing to conduits for power, since in some cases, rather than DC, AC may be used, or pulses, or power in conjunction with data etc.

The easiest way to achieve correct connectivity is to use a bridge rectifier to extract the voltage from the FPs and then use that voltage to drive the circuitry (not shown) between contact pad 1300 and a device (not shown), such as a notebook. The circuitry then, using low drop switches (i.e., bipolar solid state switches in parallel to the bridge rectifier), connects the actual contacts of contact pad1300 to the conductors of the notebook charger connector (details not shown).

It is clear that depending on the structure of the protrusions out of the plane (not shown) of the FPs and their sizes and distances between themselves, the contact pads and their contacts must be such that they cannot short between plus and minus FPs, on one hand: and that independent of the positioning on the surface, always at least one plus and one minus are connected.

In yet other situations, a complete rail may surface and depending on the dimensions and distances, the dimensions and distances as well as the geometry of the contact pad 1300 may change. In some situations, a linear array may be better or a T-shape or X-shape, or a honeycomb-cluster-of-contacts, or other suitable multi-port connection may be preferred or required over a basic kind of contact pad. A very suitable candidate seems to be a diamond-shaped contact pad, using four rather than just three contacts in conjunction with an interleaving field of round FPs as shown in Figure 13.

Depending on their sizes and geometry (for example, the FPs may be formed into diamond shapes, covering almost all of the surface with very tiny gaps for insulation, or a honeycomb pattern may be used, or just round dots as shown in Figure 13, or any other type of suitable geometry, and they may have protrusions, for example spherical, cylindrical with or without mitering, pokes etc), more than three or four contacts may be required to guarantee contact to a pair of FPs with opposite polarity to a pair of contacts on the contact pad, with shorting any FPs. A suggested approach to evaluating suitable geometries is model their connectivity by either a computer simulation or a mathematical formula. In many cases, the design of the Fps on the pad will be driven by Industrial

Design, and will necessitate all the other dependencies to follow suit.So many different variations are possible that stay within the scope of the invention that it is impossible even to list all the examples, but essentially they all end up doing the same. In some cases, it may be preferable to arrange the contact pad across the whole geometry of the portable device, rather than across only a localized group, thus allowing the weight to distribute across all contacts, ensuring a better electrical contact, rather than having all contacts of the contact pad in one corner, which might lift some of them off, unless they are spring loaded or the pad is pivotally mounted. In some other cases, the contacts may be integrated again in the enclosure of the portable device itself, with internal connections. In some cases, power may be always on to such a pad, and no sensing may be done at all, or only basic short circuit protection may be provided.

Figure 14 shows another example of a pad 1101 whose microstructure has been sectioned into sections 1401 a-n. For example, the plus of each section could be connected separately through a cable 1410 to adaptive power supply 1420, and the minus throughout the whole pad can stay connected so it is always on.

In such an example, once a device is deposited, only that section containing the device may be activated. Thus different sections of the pad could have different voltages, allowing the device not to require a regulator on the adaptor piece. So a user could then place a cell phone, laptop computer, and PDA all onto surface 1101, and the adaptive power supply would, after identifying each device, turn on either a standard voltage or a voltage specific to each device, depending on whether the devices have voltage adaptors themselves or have only identification switching devices.

<<CIP ADDITION MW p5>>

Various Ultimate Apparatuses and Methods for Implementing a Wireless Power Supply System

Figure 15 shows pad 1500 made of either conductive or nonconductive material, which has some thickness to it. Inside the pad is an inductor 1501 that can be positioned by moving arms 1510 and 1520, using, in this example, screwdrive mechanism 1511 and motor 1512 for arm 1510, and likewise screwdrive mechanism 1521 and motor 1522 for

arm 1520. Other mechanisms, such as belt drives, scissor arms, etc., may be used in lieu of this example screwdrive and motor arrangement.

Notebook 1542 has a matching inductor 1502 that may contain some circuitry. A cable 1503 comes out of the circuitry and enters the notebook 1542 standard charging circuit. In some cases, inductor 1502 may be integrated into the notebook.

As the notebook 1542 is placed on the surface of pad 1500, the controlling motors 1512 and 1522 (not shown for reasons of simplicity) are activated, for example by a command, pushing a button, weight detection, or other, similar means (described in more detail later) to detect the position of the notebook 1542 and the location of inductor 1502. This search can be performed by a controller, which may be embedded in the pad 1500 (not shown), or may be part of the power supply (also not shown), or may in some cases be controlled by the notebook itself. sending data to a small controller/receiver unit (also not shown). By scanning the surface of the pad, said controller aided by motors 1512 and 1522 can detect an area (i.e., a "sweet spot") where optimal or near-optimal coupling may be achieved, thus deducting that inductor 1502 is located on the pad surface above.

In some cases, inductor 1502 may send out a homing signal that may be used to track the location of notebook 1542. In other cases, inductor 1501 may send out a ping signal and listen for some kind of resulting echo response from inductor 1502. In yet other cases, as described also further below, other sensor types or optical detection can also be used to guide the search for the sweet spot.

Once the sweet spot area has been found, small-step increments allow positioning the inductor more accurately, and hence allow the power to be increased once satisfactory magnetic coupling is achieved. If the user were to move notebook 1542, the magnetic coupling quality would fall, which could be observed by the adaptive power supply, resulting in shutting off the power and initiating a new search sequence, reconnecting the notebook to charging again.

Figure 16 shows a different approach using an array of inductors 1601 a-n embedded in a pad 1600, which may be either conductive or nonconductive, each separately

:onnected to a controller 1602, which then is connected by a wire 1603 to a power ;upply. Notebook 1642 has a larger inductor, 1612 that, in any situation, should include it least one or several instances of inductor 1601 a-n, but in some cases it may have also ;everal inductors with or without electronic switching. Depending on the geometries of he positions of 1601a-n and the receiver coil 1612, power can then be turned on to one or nore of the inductors 1601 a-n, thus improving coupling between the receiving coil 1612 ind the emitting coils of inductors 1601 a-n.

In yet another approach, Figure 17 shows a capacitive coupling system. Pad 1700, which may be either conductive or nonconductive, although non-conductive is preferred, s divided into an array of electrodes 1701 a-n. Notebook 1742 has two distinct surfaces .712 a and b, which are connected to a power receiving unit 1714. Said unit 1741 is, in urn, connected to a cable to a power adaptor plug of notebook 1742.

Figure 17b shows that, based on determination of the notebook position, the :lectrodes 1701 x1 and x2 are selected from available electrodes 1701 a-n, forming a :apacitive transformer with notebook electrodes 1712 x1 and x2. Hence power is fed nto power preparation circuitry 1714, and then connected by cable 1715 to notebook .742.

In some cases, the pad can also be a combination, that is, one 'wire' is conductive e.g. ground) and the other is capacitive.

Figure 18 shows a few alternative methods for activation and determination of ocation of the notebook. For example, pad 1800 (which may be a conductive or ıonconductive pad, according to any of the methods described above) is partitioned into ;ections. Each section 1801 a-n may contain a sensor element 1811 a-n. In some cases, his sensor element may be a photo sensor. In other cases, it may be a simple mechanical ›ressure switch. In yet other cases, it may be a piezo pressure or weight sensor, etc.

According to data obtained by the sensors, the position of a device may be letermined, and, using information such as weight and footprint, in some cases even the levice ID may be sensed.

In yet other cases, the piezo sensors may pick up ultrasonic signals emitted by the notebook, or said sensors may ping the notebook, which then responds with an echo giving its location and type.

Alternatively, a camera 1821 may take a picture of pad 1800 and see a device deposited on said pad. Image recognition means associated with the camera may recognize the model and type of the device, as well as its orientation, and may instruct the adaptive power supply or one of the nonconductive systems to activate power accordingly.

In yet another implementation, a voice recognition system 1832 may have a microphone 1831 connected to it. The user may then simply say, "Please charge my Sony™ notebook," and accordingly, the voice recognition system would instruct the adaptive power supply or the nonconductive pad to turn on power.

In yet other cases, RF triangulation from an 802.11x type network, GPS, or other, similar means, may be used to locate the device and determine whether it is situated on a pad and thence activate that pad (not shown) accordingly. Or in some cases, a button may be provided on the pad itself or on the device that the user has to push to initiate the charging, rather than using automatic initiation of charging. Such a manual initiation of charging would avoid unintentional charge cycles.

In yet other cases, a pad deploying a conductive surface with openings may be placed above another solid conducting surface, separated by an insulating layer with slightly smaller openings (not shown). Ball-like contacts may be spring loaded and protrude from the bottom of a mobile device, some of which will "land" in holes and connect to the power plane carrying one polarity, the others resting on the top one, connecting to the top layer carrying the other polarity, hence again creating a situation where power can be sent up to a device, without having to plug in any connections, and still maintaining some freedom to move the device.

In yet other cases the current can be redirected to the proper contacts by sensing the pressure exerted by the device on the base. Once a device is atop the base surface,

pressure inside the surface determines the location of the device and routes power to the appropriate location.

In yet other cases the current can be redirected to the proper contacts by using optical sensors. Certain sensors embedded on or away from the base could detect an optical signal, such as infrared, generated by the adapter. Based on a formula dependent on the optical signal, the base can redirect power to the proper contacts. In certain embodiments the optical signal may be generated at the base or away from the base and received by the adapter.

In certain embodiments the adapter may be connected, attached, or built into the side of the laptop or mobile device. In the event the adapter is united to the side of the mobile device. the adapter would contain contacts that connect to the bases' contacts. In yet other embodiments, the adapter may be attached to the top of the device or the screen of the laptop. In such cases, when the laptop screen is fully open the power could transfer from the contact on the base surface to the adapter on the laptop or the mobile device.

Many other approaches may be used to mimic the same method and apparatus, even if some of the details are modified so they do not exactly match the examples presented herein.

APPENDIX F

Enhanced RF Wireless Adaptive Power Provisioning System for Small Devices

Inventors: Tal Dayan, Ofer Goren, Dan Kikinis and Yehuda Goren
Attorney Docket No. 6041.P006z

Background

This disclosure incorporates by reference co-pending patent application titled "Alternative Wirefree Mobile Device Power Supply Method and System With Free Positioning" filed 08/01/2002, application number ________, Attorney Docket No. 6041.P005.

One other approach for wireless powering of small mobile devices is using inductive coupling. Although mentioned in the co-pending application, it is a tricky approach. Leakage is the biggest problem, but load matching, inducing eddy currents in untargeted objects and hence heating them, or shorting the supply are just a few to mention.

What is clearly needed is a method and system to improve the yield by doing a finely tuned microprocessor-controlled, narrow-band resonance coupling, hence improving the coupling to almost no loss in the near field, and at the same time keeping the far field virtually zero.

Description of the Embodiment

Figure 1 shows a pad 100 in which a coil 101 is embedded. The coil is driven by a power oscillator 102 (power source not shown) and is controlled by intelligent controller 103, which may contain a microcontroller. Also shown is the near field 110 and the far field 111, which are available. The near field is defined typically as the field within the geometry size of the coil itself (i.e., if the coil is 5 inches in diameter, the near field would be that order of magnitude, whereas a point 50 inches away would be considered in the far field), while the far field is typically defined as the field seen from a distance of a multiple of the geometry of the device. Typically measurements for EMI are done at a distance of approximately 5 meters or more from the device, and actually they are mostly measuring the far field, whereas near field sniffer ports are used only for determining potential leaks, etc.

Figure 2 shows a notebook computer 200 with a coil 201 attached to its bottom. Also attached is an RF-to-dc converter 202 and a dc plug 203 that is connected to converter 202 and plugged into a normal dc power supply pin of the notebook. It is clear that in some cases, the receiving system consisting of coil, RF/dc converter, etc., may be integrated into the host and not require an external supply connector. In some cases the RF-to-dc converter is an intelligent-type regulator, in other cases, it may be simply a basic diode/capacitor rectifying system or any type in

between. As described earlier in co-pending patent application number _______, Attorney Docket No. 6041.P005, an array of coils can be used to improve coupling by always allowing a "reasonable" set of inductors/antennae to be found between the base and the device. A normal type of MOSFET can be used to switch, using a small dc bias to enable switching and sending the RF energy on top.

Figure 3 shows a schematic overview of the electrical circuitry of the system. Power generator 102 drives the inductor coil 101 in the pad. In some cases, the inductor may not be an actual coil, but rather an antenna with microwave strips, etc., depending on the frequency selected. In yet other cases, it may be integrated into a PCB, etc. Typically, such a device would operate in either the 900 megahertz or in the 2.4 gigahertz range, but almost always in an industrial, scientific and medical (ISM) band, so slight leakage in the far field would be deemed acceptable. In one case, a 13.5 MHz ISM band is used, with a plurality of coils embedded in the base unit. That frequency (also an ISM band) lends itself nicely, since it is high enough to not require expensive ferrite cores, but is low enough to provide high power with little skin effect. Trying to reduce skin effect could dramatically increase the cost of the coils. The switches used in a matrix, as described above, should have a transit frequency of at least 5x the primary carrier (i.e., Ft =100 MHz > 5*13.5 = 67.5 MHz), which are still economically feasible.

Regulator 103 shows more detail. In particular, it measures the power sent into the coil 101 by the means of sensing across the voltage wires and measuring at sense resistor 104 to determine how much power is actually drawn. The results would then be used by regulator 103 (i.e., a microprocessor, not shown) to drive the controls of the oscillator 102. These controls may include one or more of the frequency, frequency spread (that is, the bandwidth), and total power pushed into the inductor (or transmitting antenna) 101.

The recipient antenna or inductor 201 forms, with capacitor 201a (previously not shown), a resonance receiving antenna system that is narrowly tuned. The higher the Q (quality quotient of the resonance circuit), the narrower the band it draws power on, and the better the coupling between the two, even if the mechanical situation is not ideal. Converter 202 is the ac or RF-to-dc converter, shown here with a bridge rectifier capacitor, an electronic regulator block, and another filter capacitor before going to dc connector 203.

The quality of this circuitry may depend a lot on the Q , but also on the capability to control multiple loads. In some cases, a regulator may be contained in the host device, such that communication received in the host side regulator could include, for example. FM-modulated, AM-modulated, or other data that runs on the same carrier (frequency) that is carrying power. and such data can be introduced by controller 103 by modulating the center frequency of oscillator 102, or other appropriate means to achieve the desired type of modulation (not shown).

Figure 4 shows a further simplified circuitry with the oscillator 102, the intelligent controller 103, the sensing resistor 104, and a load resistor 401 that represents the equivalent power load that is "seen" from the oscillator, in the case of an ideal resonant coupling of both coils and or antennae.. The reactive component of Z_L, which can be determined by regulator/controller 103' using its sense lines over Sense Resistor 104 (R_S) lets regulator 103' determine coupling and transmission (transformation) ratio, of the actual situation, allowing a crude first regulation that compensates for the transformation ratio between inductors. Further, the communication link allows fine tuning by communicating between both sides. The back pass of the communication may be done by modulating the load signal, resulting in a specific pattern at the gross regulator on the primary side.

It is clear that by managing the power regulation on the receiving side, the semblance of Z_L may be tweaked. It is also clear that by controlling multiple devices and communicating among said devices, an overload of the circuitry, for example, may be avoided, in case too many devices try to share one pad. A signal could be sent that allows only certain devices to participate, with others being told to delay charging. In yet other cases, the frequency of resonance of different devices may be slightly skewed, thus allowing multiplexing of power distribution by not tightly coupling all devices at the same time. Such an approach would be suitable for the times when greater amounts of power are needed in one or another device, because only certain devices would receive energy at a given time, depending on their resonances. Multiplexing could be done by frequency hopping on the oscillator side, or by other means, such as communicating and telling power regulators to back off.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novelty of the art of this disclosure.

APPENDIX G

ENHANCED RF WIRELESS ADAPTIVE POWER PROVISIONING SYSTEM

nventors: Tal Dayan, Ofer Goren, Dan Kikinis, Yehuda Goren
\ttorney Docket No. 6061.P007z

3ackground

With the advent of wireless power services commercially available to the public, there will be demand for such ervices in public places such as, for example, coffee stops, bus stations, air ports, hotel lobbies, buses, even irplanes, etc. Even though power consumed per user is not that great, when multiplied by millions of users, the ost of consumed power can become a valid business consideration. Also, this technology lends itself to allowing igh bandwidth network communications, and therefore, a billing mechanism may be desired.

What is clearly needed is a method that allows an established account user to have a billing mechanism to bill im for actual usage or for a flat fee, and in any case to verify the permissions that the user has and accordingly nable and disable access to power, the network, etc.

)escription of the Embodiment

Figure 1 shows a table 101 in a coffee shop 100 that has, for example, four sections 102 a-d. On one of the ections (section 102b) the user has installed himself by setting down his notebook 105, his cell phone 106, and half cup of cappuccino 110.

Figure 2 is an overview diagram of the network connectivity required. In this example, only cell phone 106 is hown, sitting on table section 102b; however, it is clear that more than one device may be connected at one time. 'able section 102b is connected to intelligent controller 201, which has access to a power source 203 and also ccess to network 204, typically going through a router/firewall device 205 and Internet connection 211 to the nternet 210, from where a connection 212 leads to a server 220 that maintains the user's account.

According to the user's preferences an account has been set up on the server that describes the features of the ccount, such as power, networking, etc., and the means of payment, for example, by time and/or actual power usage nd/or megabytes of data uploaded or downloaded. All this data for each account is on file in a database (not hown) on the server.

The account services may be charged as a flat monthly fee, and a record of the megabytes used kept only for nternal usage, or the account may be billed by megabytes transferred. The fee structures may be in place for power sage: it may be billed as a flat fee for usage, or the fees may be on an hourly basis, where, for example, the user

gets X hours of charging time, regardless of whether he uses the power for one or for multiple devices.

To invoke the account services, the user may go to a Web site where he can register his devices to his account. Hence when the device ID comes up, the server knows which account permissions to retrieve.

Figure 3 shows a simplified flow diagram of the process of the novel art of this disclosure. In step 301, a device is set on the table section. In step 302, the presence of the device is detected. In step 303 the ID is obtained from the device, as described above. In step 304, that ID is sent to the server and is looked up to identify the user account. Then in step 305, according to the account permissions, a record that OKs the usage and gives limits, rates, etc., is sent back and received. In step 306, the power and/or network restrictions for an unauthorized user are lifted, and the user is free to use power and networking services provided by his account for his device.

The structure of the database is not described here in detail, but no special technique is required. It is well known in the art how to design databases that can look up, for example, an ID that is associated with an account and can obtain account-related information.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novelty of the art of this disclosure.

APPENDIX H

Modifying Surfaces of Devices to Integrate Them Into Wireless Charging Systems

CIP MW 005 and 006 (inductive)

Inventor Tal Dayan, Ofer Goren, Pandurangan Ramakrishnan, Dan Kikinis
6041.P008z

Co-pending provisional applications MW 006, MW 007 are incorporated by reference.

Background

Very often an existing portable device needs to be upgraded to support wireless power. However, gluing contacts on the outside may not always be suitable, for various reasons. For one reason, the contacts may be torn off easily from a device such as, for example, a notebook computer, which is pushed in and pulled out of a carrying case frequently, where the contacts may easily catch on the zipper, etc. For yet another reason, some devices may have a pronounced curve to their external plastic surfaces, which may reduce that ability to make a proper connection or easy gluing of an add-on solution. [2:00]

[2:40]Figure 1 shows an example in current art of a cell phone 100 that has a removable battery pack 111. The battery pack is attached to the outside enclosure of the phone, as shown by dotted line 101. The battery pack has a latch 112 that hooks into a slot 102 on the cell phone to facilitate removal of the pack and attachment of the pack to the phone. Typically, such a battery pack has at least two contacts, shown here as contacts 113 a-n on the pack, that match with a set of contacts 103 a-n on the phone when the battery pack is attached to the phone, as suggested by arrow 120. [3:30]

[3:30]Figure 2 shows a similar system, but of the type where the battery and its enclosure are two separate parts. Again, the position of the battery when attached to the phone is shown by dotted line 101in the outline of the phone 100. However, in this example, the battery 211 with contacts 113 a-n is separate from the battery cover 221, which has a latch 212. The cover has to be put on after the battery is properly situated and connected. Depending on the system, the battery, rather than just having contacts, may have a short cable (not shown) with connectors that plug into a connector on the phone to secure the contacts. After the battery contacts are plugged into the phone contacts, then the cover 221 is put on over battery 211 *in situ* in phone 100. [4:33]

[2:00]What is clearly needed is a system wherein a battery pack, for example, or an enclosure of a

battery pack, or an enclosure of a device may be replaced by one that has integrated contacts, thus avoiding the problems or providing a solution to the problems that would arise out of gluing on additional contacts. Furthermore, such or further additional contacts may be designed to allow powering of a second device in addition to the original, primary device. [2:40]

Description of the Embodiment

[4:36]Figure 3 shows a phone of the style shown in Figure 1, but with multiple alternatives of the novel art of this disclosure. For example, battery pack 111b has been changed to contain an active area 320, as described in previous co-pending applications. Pack 111b shows the battery pack flipped upside down, so now the contacts 313a and 313b are visible, as well as a dotted line that indicates the control circuitry 314 that has been added inside the battery pack. Even though the example discussed is a cell phone, essentially the same applies for all kinds of portable electronic, including, but not limited to cell phones, notebooks, PDA's, still and video cameras, portable video and audio players, any hybrid combinations and other mobile, not yet conceived devices etc.

Often battery packs already contain some circuitry, so rather than a separate add-on, additional new circuitry could be simply integrated into the internal circuitry of the battery pack, such as in area 320. Therefore, the phone would not "see" any change in its electrical capabilities. Some batteries in current art already have external contacts that allow the battery to be charged from the outside while the phone is, for example, in a cradle in a car or on a desktop. Those external contacts could be used for the activities of the novel art of this disclosure as well by extending the contact sizes to match the requirements of the upgraded system.

Those additional shell parts, batteries, contact sets and wires may be sold as upgrades, much like faceplates for phones are sold today in retail stores, often as an after market module. In some cases however, the changes, upgrades and additions may pertain to other subsets of a system than just shell or battery, including but not limited to memory card, CD player, other attachable peripherals etc.

Additionally, on the phone body 100 itself the top portion of the cover may be removed and replaced with a cover that has integrated contacts such as contacts 323a and 323b. Circuitry 314 could be hidden under contact 323b, and a connection to the phone 100 could be established through wires 324 and 325. Similar replacements are made today for purposes of cosmetic upgrades to cell phones. For example, in

many cell phones the face plate can be changed. and for some cell phones, kits are available to add lighting effects to such a cosmetic cover. including a wire that is inserted between the phone and the battery to power the LEDs that generate the lighting effects. Wire 325 may be connected in a similar way to interface between the phone 100 and the battery 111b. If such modification are introduced, the cover could in some cases for example, have contacts that allow a second phone or other, similar device to be powered while the primary battery is charged. [7:25]

Figure 4 shows an approach for a battery pack that has a separate cover, as previously shown in Figure 2. The novel art is similar to that described for Figure 3, above; however, because the batteries in this situation often have wires, the battery may be. for example, plugged into circuitry 314, which is contained in battery cover 221b (221b from the other view). That circuitry would then have a wire 430 that connects to the phone instead of a wire or wires from the battery (not shown). In other cases where the battery doesn't have its own wire, a wire may be inserted between the battery and the phone to properly connect and be able to charge the battery and power the phone..[8:25]

Figure 5 shows another approach, for a notebook computer. it is a further elaboration of the case discussed above. where contacts are added to the case or shell, allowing a second device to be charged and or powered. In this example, notebook 501 typically has a base side 503 and a lid 502 that can be flipped up. It stands on active surface 500. which is connected via cable 520 to power supply 521. which in turn is connected through wire 522 to main ac power. On the top of lid 502, the outer covering has been replaced to contain an active area 510. as described in previous co-pending applications, where devices such as a couple of cell phones. PDAs, or other, similar devices may be charged. The control circuitry may be included in the device. such as the notebook. or in other cases. the contacts offered may just be a pass thru, and control comes from the main control unit of the main pad, surface etc.

As discussed earlier <<note to attorney: in previous apps)>> other methods than direct contact may be used, such as the other wire free charging methods (induction, RF, capacitive etc) . and those components may be integrated in a similar analogous manner into replacement shells etc.

When replacing the battery and or the shell or components thereof, mechanical changes to the original design may be made. For example, the new battery can be larger to contain room for necessary electronics,

elongated to touch an existing power input contactor or the shell may have a different shape (e.g. flat) than the original.

APPENDIX I

Enhanced Contact Systems for Surfaces and Devices
CIP MW 008

Inventors: Tal Dayan, Ofer Goren, Pandurangan Ramakrishnan, Dan Kikinis
6041.P009z

Background

The system discussed in co-pending application titled "MODIFYING SURFACES OF DEVICES TO INTEGRATE THEM INTO WIRELESS CHARGING SYSTEMS", Attorney Docket No. 6041.P008z, filed 09/17/2002, and the co-pending applications referenced therein requires in some cases that the contacts on the device and its corresponding surface must have a satisfactory contact. In particular, if a device has more than three legs there is, at least theoretically, the chance that one of the legs may not touch. If said non-contacting leg is a contact leg, the non-contact may likely result in a malfunction of the system.

What is clearly needed is a system with a mechanism that by spring-loading or other means allows the contacts to have additional freedom of movement to improve the chances of proper contact between the leg and the matching area on the corresponding surface.

Description of the Embodiment

Figure 1 shows the bottom of a device 100, which could, for example, be a PDA or notebook. The bottom case shell 110 of device 100 has standard rubber feet 101a and 101b. It has also two special contact feet 102a and 102b. A cross section AA of a standard rubber foot 101b is shown in more detail in Figure 2, and a cross section BB of the enhanced foot according to the novel art of this disclosure is shown in Figure 3. It is important to the novel art of this disclosure that feet 102a and 102b have additional freedom in their range of motion so they can move forward and backward as indicated by motion arrow 114, left and right as indicated by motion arrow 113, and vertically as indicated by motion arrow 112. The range of motion indicated by motion arrow 112 is the most important, to guarantee that all four legs, and in particular contact legs 102a and 102b, properly contact the required areas of the corresponding surface.

In some cases, a unit may, as shown in Figure 8, use only two feet (both conductive), as shown in Figure 8a and Figure 8b, or three feet (at least two of which are conductive), as shown in Figure 8c, such that the two conductive feet (indicated by shading in the outline of the feet in Figure 8c) are guaranteed to touch the surface, eliminating the need for flexibility in the z axis.

Figure 2 shows the cross section AA of a standard rubber foot 101b. Typically a holding form or shape is molded into the shell 110. A rubber foot cutout in a matching format 101b is inserted and typically secured with glue (not shown). In some designs other methods of securing the foot to the shell may be employed, such as pins, screws, stakes, wedges, notches, etc.

Figure 3 shows a cross section BB of foot 102a, with motion arrows 112, 113, and 114 showing the range of motion. It is important to the novel art of this disclosure that bottom shell 110 has a holding shape 316 molded to it. Conductive foot material forms a disk 302, which in this example is held back by a bolt 301 and is spring-loaded by spring 303. In other designs, a foam material, for example, may be used instead of a spring. This arrangement allows the required freedom of range of motion indicated by arrows 112, 113, and 114. A gap 314 between the conductive foot 302 and the retainer ring 316 (holding shape) provides space for horizontal range of motion in all directions; while the spring extension 303 provides space for the required vertical range of motion by pushing the bolt head 301 into the device. Also important is wire 315, which connects to bolt 301 and delivers the electricity to the circuitry inside the device (not shown).

Various modifications to the details of this design may be made; for example, multiple springs may be used instead of one spring, or multiple bolts may be used instead of one bolt. Also, the shape of the foot may be triangular, square, elliptic, or any other shape, instead of just round.

Figure 4 shows an enhanced method for low-cost manufacturing of the conductive pad. A small section 400 has four contacts. The pad, depending on its design, may have multiple sections, each with multiple contacts. These contacts may be stamped from a sheet of slightly springy steel 400. There is a cross-connect 401 between the rows and the rows 402a, 402b, etc. In each row is a number of contacts, such as 410a1, 410a2, etc., and 410b1, 410b2, etc. Depending on the size of the total pad, there may be a more, even many more, sections 400, and each section may have its own set of connected contacts, where as neighboring sections are isolated from one another and connect to the controller as described in the earlier applications.

In other cases, the sheet metal may have many other shapes, such as, for example, stamped bumps instead of raised flaps. Also, it may be made of separate pins or rivets that are inserted into the metal sheet, as long as parts of the metal are exposed in the top layer or protrude from it. In yet other cases, the sheet

metal may be molded into the plastic or the plastic may be molded separately and then the metal contacts may be inserted into the plastic. Also, the exposed metal contacts may form an aesthetic pattern, have any of various different sizes and shapes, etc.

Figure 5 shows a side view of the same stainless steel sheet section 400. Cross-connect 401 is at the end and members 402 a-n (all one behind another) are going across, and contacts 410 a-n1, 410 a-n2, etc., are distributed along. Since all contacts in a section line up, they can not be seen individually.

Figure 6 shows a small section with one contact of the sheet 400 in a mold. Cross member 402 a-n rests on distance pins 610 a-n, which are strategically placed throughout the mold. Spring contacts 410 a-n #1-n touch the upper side of the mold at contact points 611 a-n #1-n. Depending on the design, there may be a slight cavity, which will result in a slight protrusion of the contact after the injection is finished.

Cavity 620 is then injected with a specified material. According to the design specifications, the material may be slightly rubbery or somewhat flexible, and it may vary in colors and textures. Cross section 601 is the mold top and cross-section 602 is the mold bottom.

Figure 7 shows the resulting pad 720. The thickness of pad 720 matches the opening of the cavity 620 in Figure 6. Surfaces 410 a-n #1-n protrude on the top side, thus allowing for connection with feet of devices as discussed earlier.

Not shown, for reasons of simplicity and clarity, is the wiring that connects each section of spring steel insert to the controller and power supply of the device, as discussed in previous co-pending applications. Depending on the number of contact zones, multiple wires may be embedded in the mold, and the mold may have provisions for holding said wires in place during the injection process. In some cases the wiring may be done by having an extended steel frame, similar to the lead frame used in the manufacturing of integrated circuits, rather than attaching wires individually. All the wires carried by those extended lead frames could then terminate at one connector at the side of the finished pad, and could there be connected to a controller and/or a power supply, as described earlier.

Typically the spring metal sheets could be loaded into the mold either manually or automatically. They would then be secured in a certain position with pins such as 610 a-n. Those pins may have additional features, such a protruding smaller pin fitting into a hole in the spring sheet, to ensure absolute, precise positioning. Additional pins may be provided to hold wiring down while the plastic flows into the

mold.

It is clear that many modifications and variations of this embodiment may be made by one skilled in the art without departing from the spirit of the novel art of this disclosure.

The cost advantage of this design is that stamping the steel contacts should result in lower manufacturing costs.

APPENDIX J

Small Geometry Pads and System for Wireless Power Supply

Inventors Tal Dayan, Dan Kikinis, Ofer Goren, Pandurangan Ramakrishnan
MW 012

Background

Although the system described in previous co-pending provisional application titled "Enhanced Contact Systems For Surfaces And Devices" filed 09/25/2002, Attorney Docket No. 6041.P009z, application no. 60/413,791, of which this disclosure is related, is very useful, sometimes only certain aspects of its novel art are required in a low-end, limited-usage application. In particular, for very inexpensive, low-end devices, it may be wasteful to integrate a full system into the basic product.

What is clearly needed in such cases is a simplified, basic pad that allows the user to start with a low-cost minimum solution, but also allows system upgrades at a later time.

Description of the Embodiment

Figure 1 shows a mobile electronic device, such as a mobile telephone 110. It has two contact zones 111a and 111b, as described in the previous co-pending applications. Instead of a full pad with many zones, in this case the system has only a small pad 100 with only two contact zones, 121a and 121b. Power supply 123 may be a very basic power supply, or even the standard power supply of current art that is sold with the device 110. It may have only limited capabilities or even only capabilities to operate that one single device. In some cases, such a small pad can be integrated in a larger equipment such as car dashboard, furniture, treadmills, etc.

The user simply puts the phone 110 down onto pad 100, thus establishing an electrical circuit.

Figure 2 shows the phone 110 on pad 100. It is clearly visible that phone contacts 111a and 111b are aligned with pad contacts 121a and 121b. The angle omega 222 between device main axis and the pad main axis does not have to be exactly zero degrees. Omega 222 may be 10 degrees, 20 degrees, or even as great as 45 degrees. In some cases, it can also be rotated by 180 degrees in addition to the slight angles mentioned above.

In some cases, pad 100 may be bounded by a small frame (not shown) to limit the range of omega

222. That frame may have an opening to accommodate protruding features that are characteristics of the device, such as the antenna, so that placing the device in the frame with the protruding features in the corresponding opening would also restrict the omega 222, without, at the same time, requiring precise insertion, as would typically be required when a device such as phone 110 is inserted into a charging cradle (not shown) of the type used in current art.

Figure 3 shows another embodiment of the novel art of this disclosure. Phone 310 may have two or three contacts 311a, 311b, and, optionally, 311b . Circular pad 300 has a center contact zone 321a, an outer contact ring 321b, and a no-contact zone 321c, which lies between zones 321a and 321b. Pad 300 is connected by wire 322 to power supply 323 (may be the same as power supply 123), which in turn plugs in to main ac power source 324.

As shown in Figure 4, in most cases, the phone 310 may be casually set down onto pad 300. Due to the circular nature this embodiment, there is no limit to the omega 422 of alignment of the phone with the pad. Pad 300 may in some cases have a raised edge at its outer perimeter to force the phone into correct contact with the pad; however, there may be a gap of a few millimeters (a quarter-inch to a half-inch) allowing convenient, sloppy application, rather than requiring precise positioning, as is generally required with insertion of a device into a power connector or cradle in current art.

In some cases, due to the small nature of these pads, a plastic clip-on or slip-on cover (not shown) may be used that has openings for the contact pads, allowing the user to customize the look and possibly the feel of the pad. Options could include different colors, flags, transparency, rubbery or fuzzy coatings, etc.

In some cases even additional lighting effects (not shown) may be offered, such as blue pulsing during charge, low-level blue when trickle charging, red flashing when mis-connected, etc. Alternatively, the light color could change to indicate the level of charge, much as some a fuel gauges indicate the fuel level, starting with red or orange ("empty") and thence progressing to yellow, green and finally blue (everything is "cool"). In some cases the lighting effects and other functions may be added by the user as a plug-in option into an existing, basic passive pad.

Further, many modifications and/or additions may be made without departing from the spirit of the invention. For example, in many cases, typically, a power supply may have a current limit or other

protection mechanism, so the pad may be completely passive, to satisfy safety requirements.

Further, in some cases, because a device may have a dc/dc regulator able to accept a wide range of voltages, no issues would occur if there were no exact match. In yet other cases, devices may have a protection mechanism that would pass the power to the device only when the voltage and current are in range, as described earlier in previous applications. In yet other cases, a device may include an automatic polarity routing (e.g., active or passive rectifier bridge). The attached appendices A, B, C, D, E, F, G, H, and I are incorporated herein by reference.

In the Claims:

1) An apparatus comprising:

A mobile electronic device having two electrical contact zones, the mobile device to be placed on a pad having two contact zones corresponding to the two contact zones of the telephone, the pad receiving electrical power froma power supply, when the two contact zone of the telephone are placed in contact with the two contact zones of the pad an electrical circuit is established.

2) An apparatus comprising:

A pad receiving electrical power from a power supply, the pad including at least two separate groups of electrical contacts zones of separate densities.

3) The apparatus of claim 2, wherein the two different zones are indicated by accordingly differet colors.

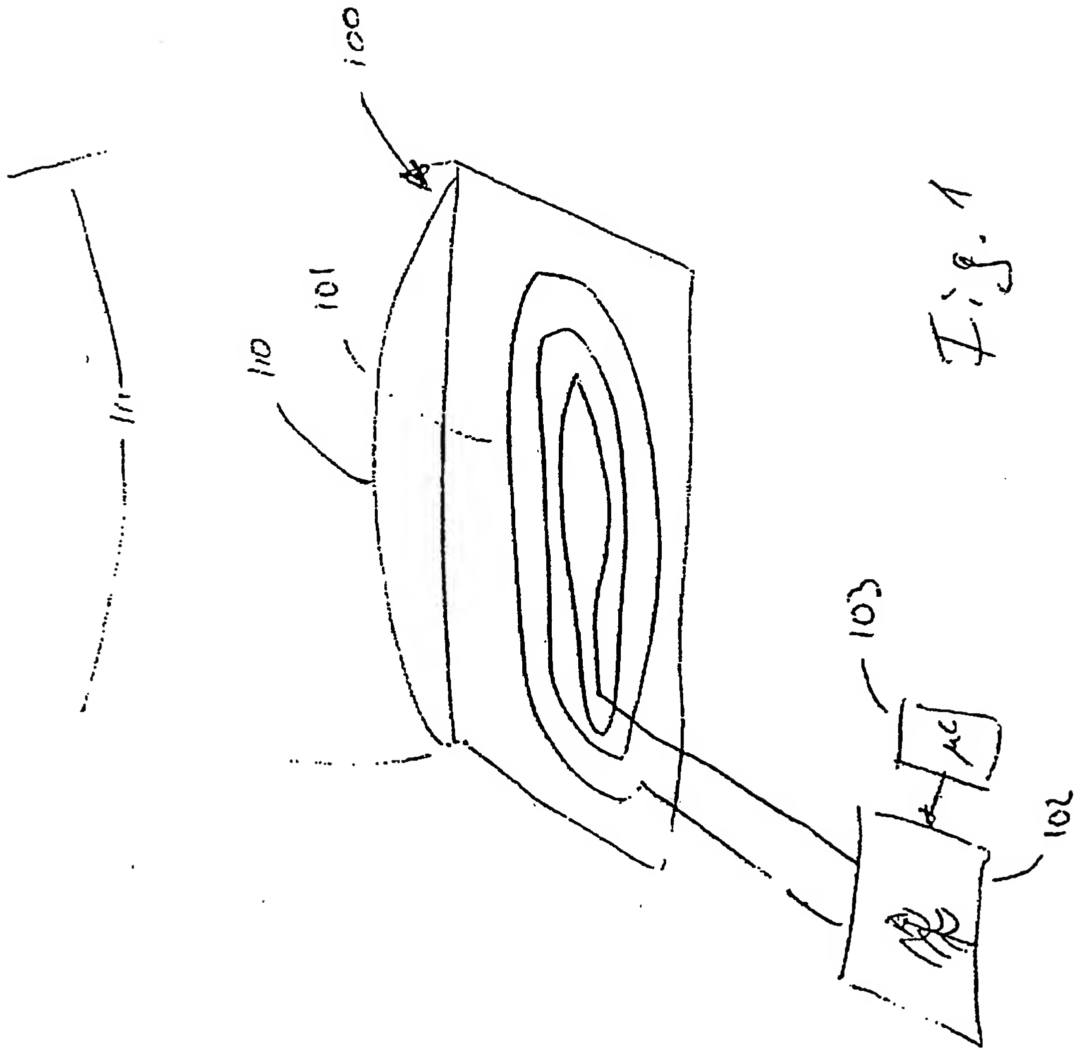


Fig. 1

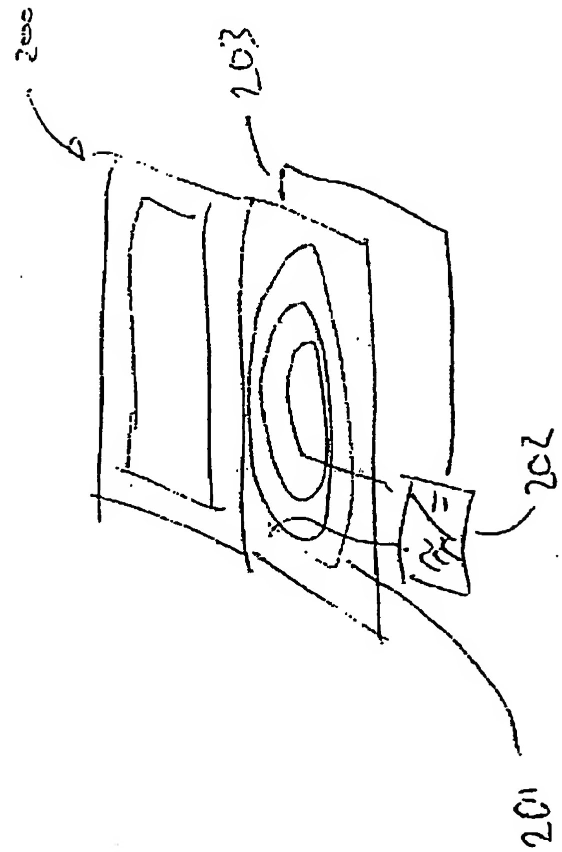


Fig. 2

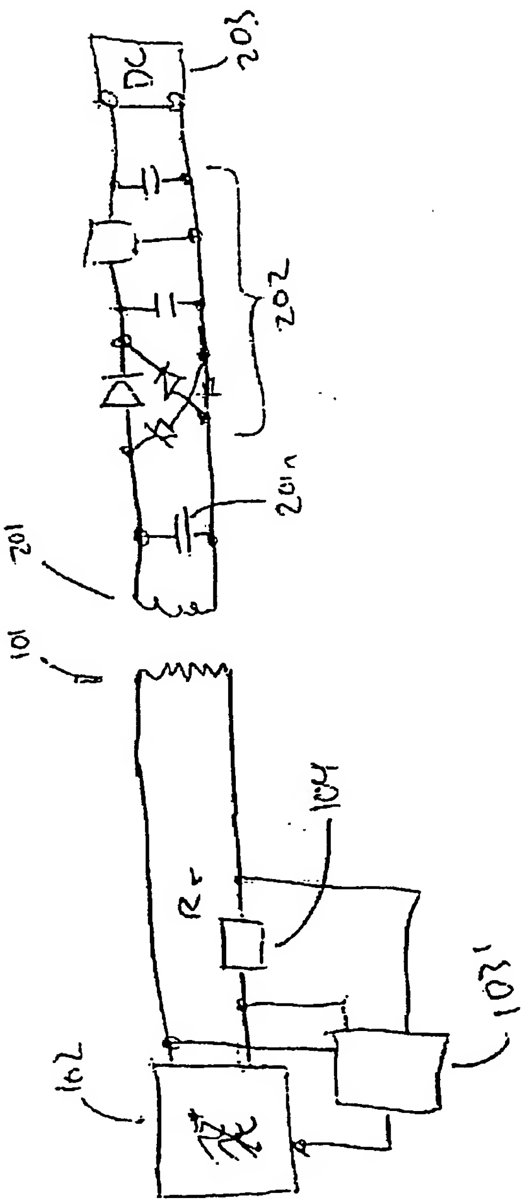


Fig. 3

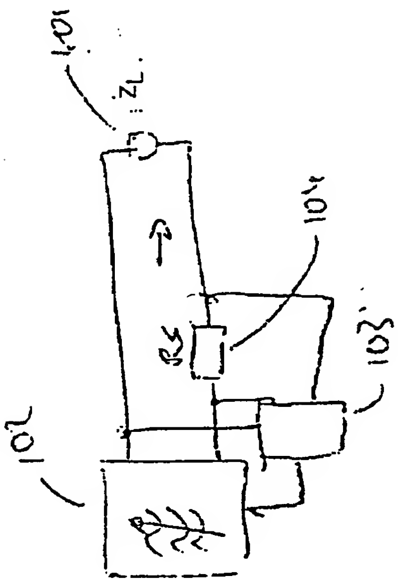


Fig. 4

DRAWINGS:

Figure 1:

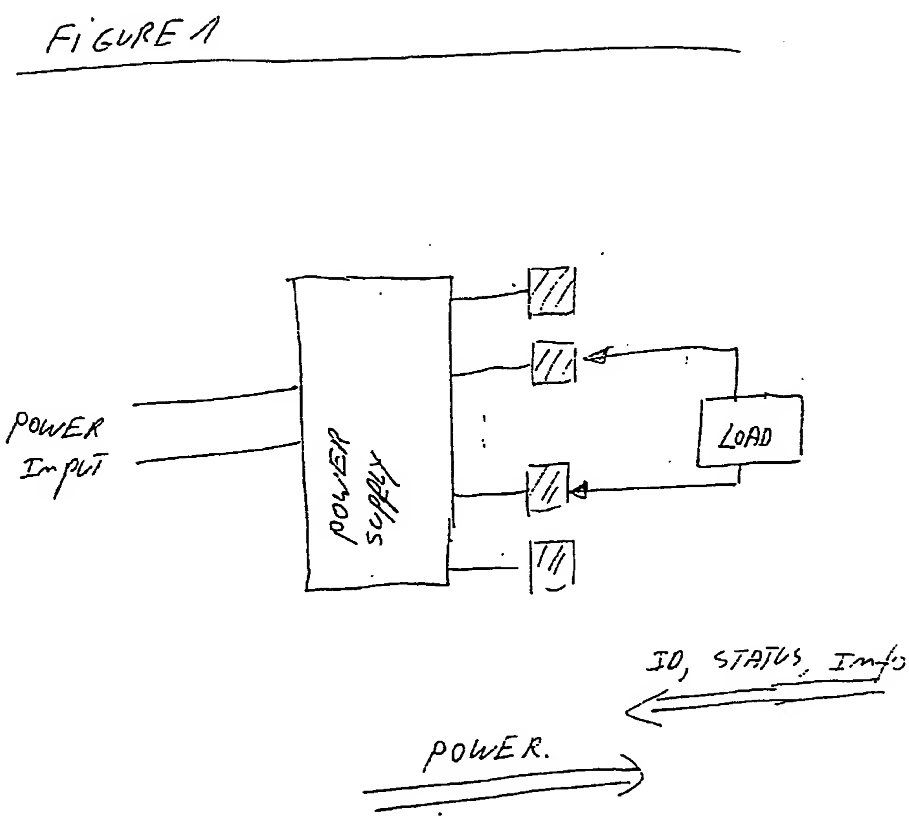


Figure 2:

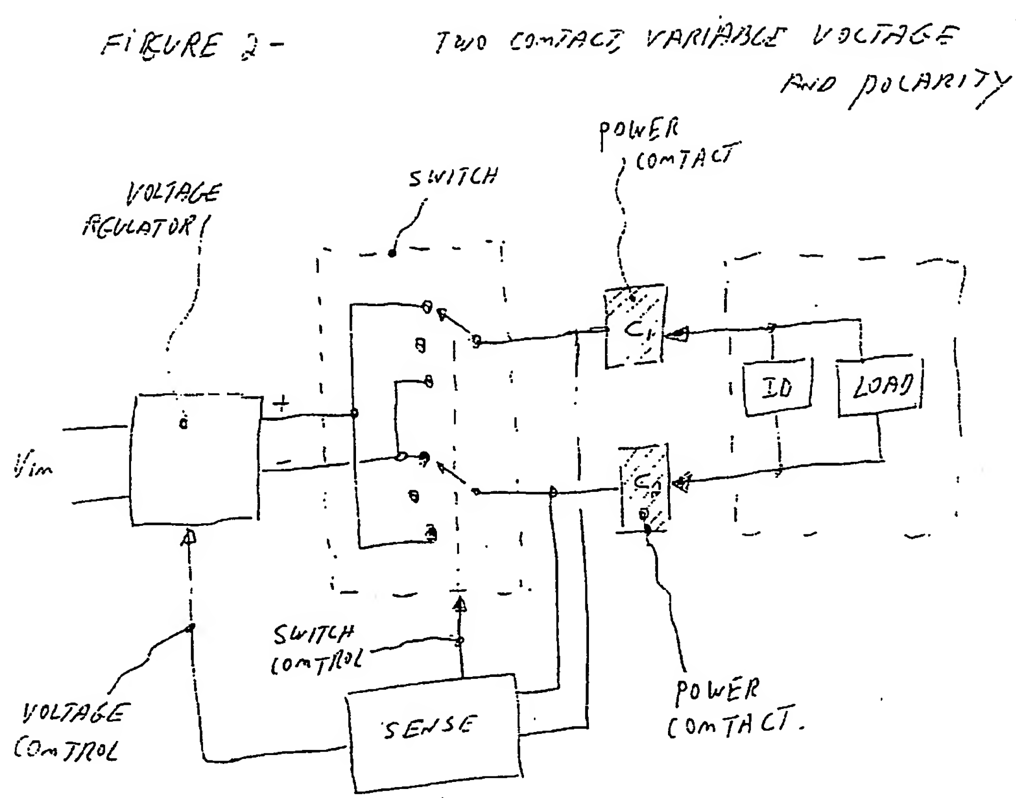


FIGURE 2 - TWO CONTACT VARIABLE VOLTAGE AND POLARITY
POWER CONTACT
SWITCH
VOLTAGE REGULATOR
C1
C2
ID
LOAD
+
-
Vin
SWITCH CONTROL
VOLTAGE CONTROL
SENSE
POWER CONTACT.

Figure 3:

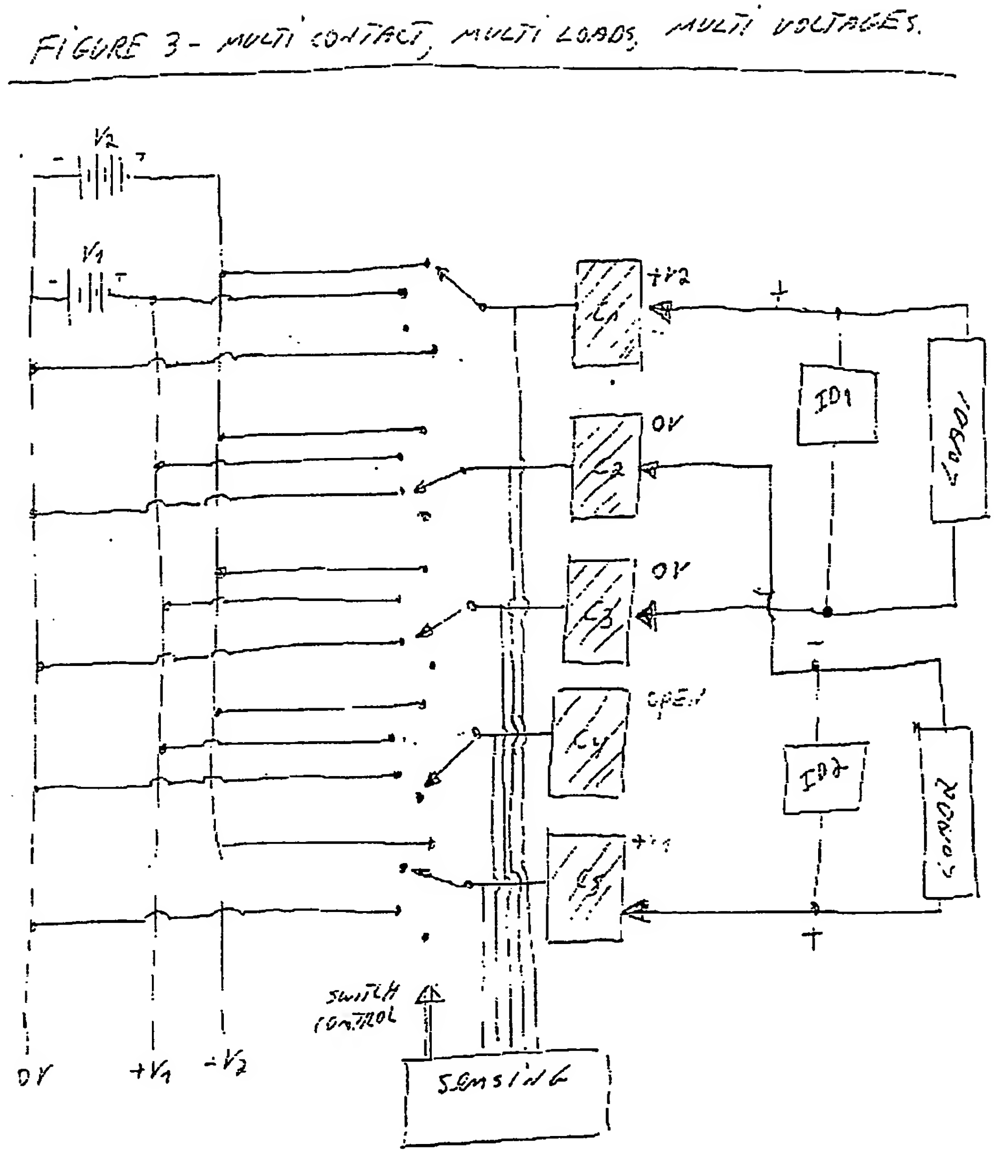


FIGURE 3 - MULTI CONTACT, MULTI LOADS, MULTI VOLTAGES.
V2
V1
+V2
0V
0V
OPEN
C1
C2
C3
C4
C5
ID1
ID2
LOAD1
LOAD2
SWITCH CONTROL
SENSING
0V
+V1
+V2

FIGURE 1 THE THREE LEVELS OF FREEDOM

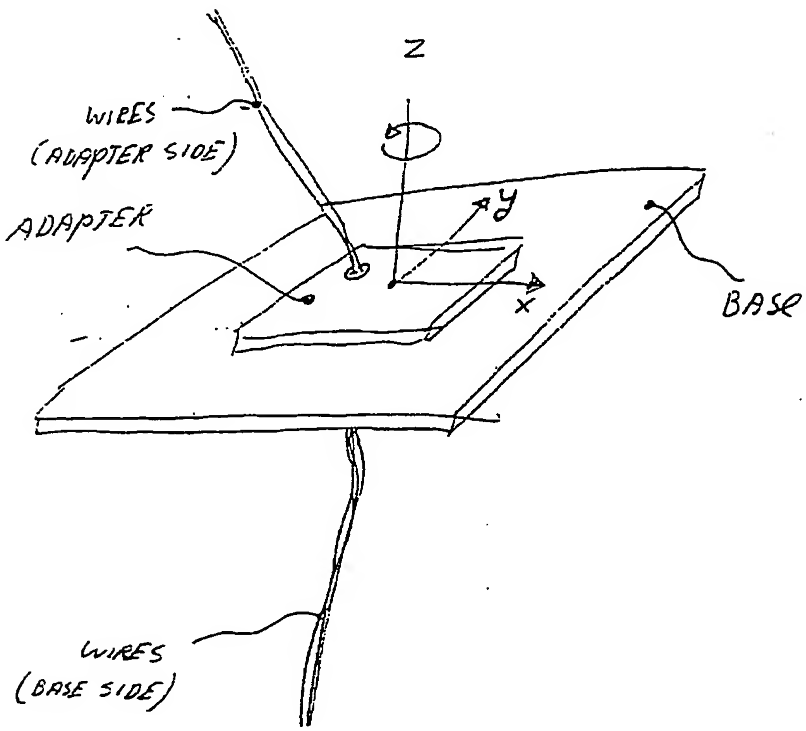


Figure 2:

FIGURE 2 - A Close CIRCUIT THROUGH A1-B1, A2-B2

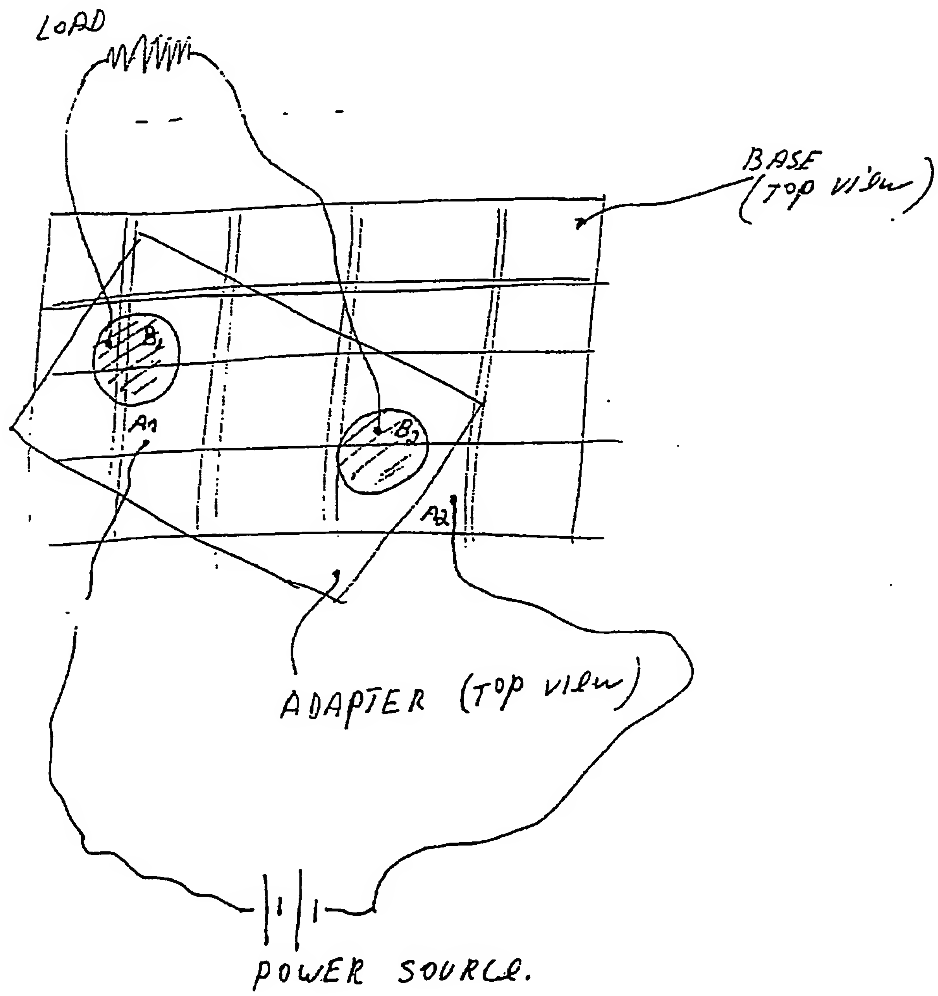


Figure 3:

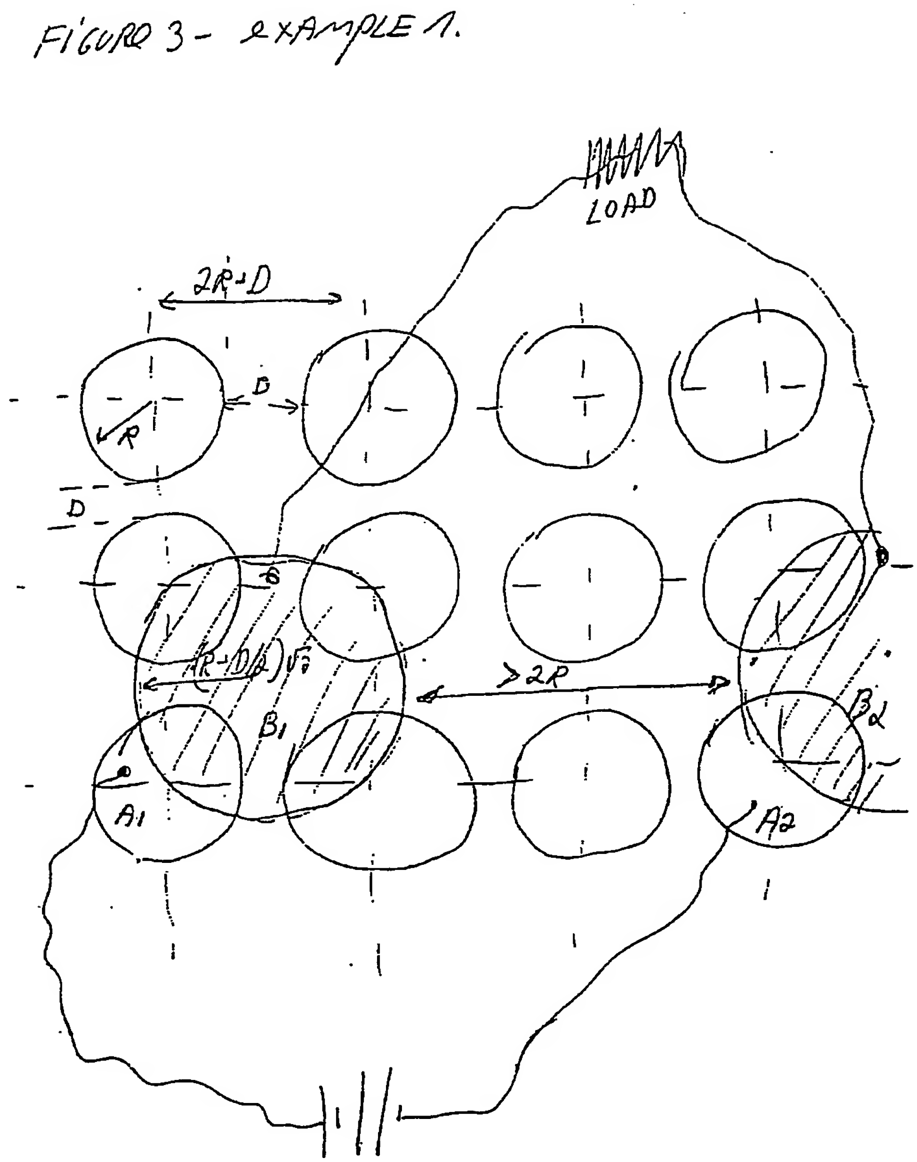


Figure 4:

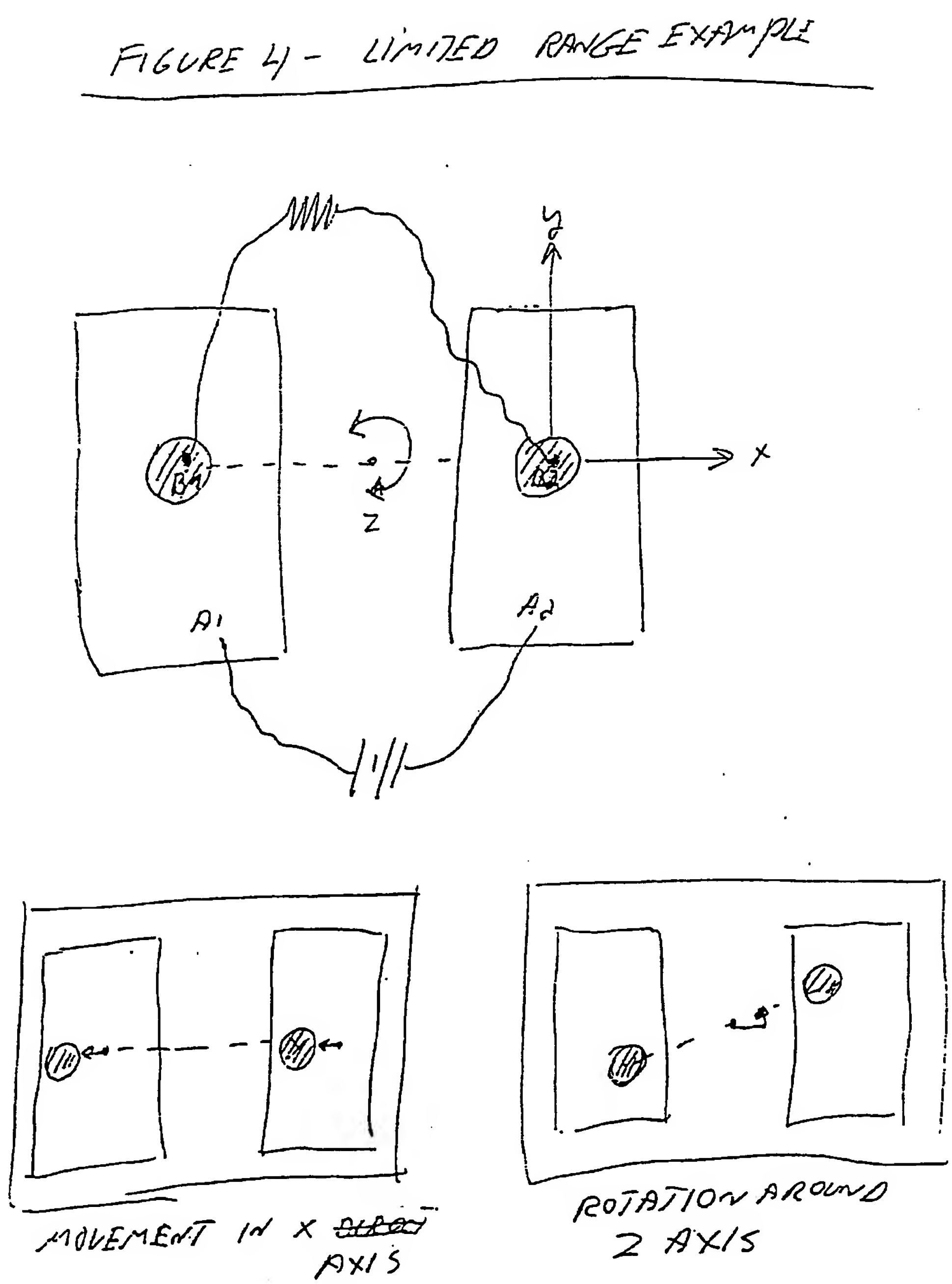


FIGURE 4 - LIMITED RANGE EXAMPLE
y
x
Z
B1
B2
A1
A2
MOVEMENT IN X ~~DIRECT~~ AXIS
ROTATION AROUND Z AXIS

DRAWINGS:

Figure 5:

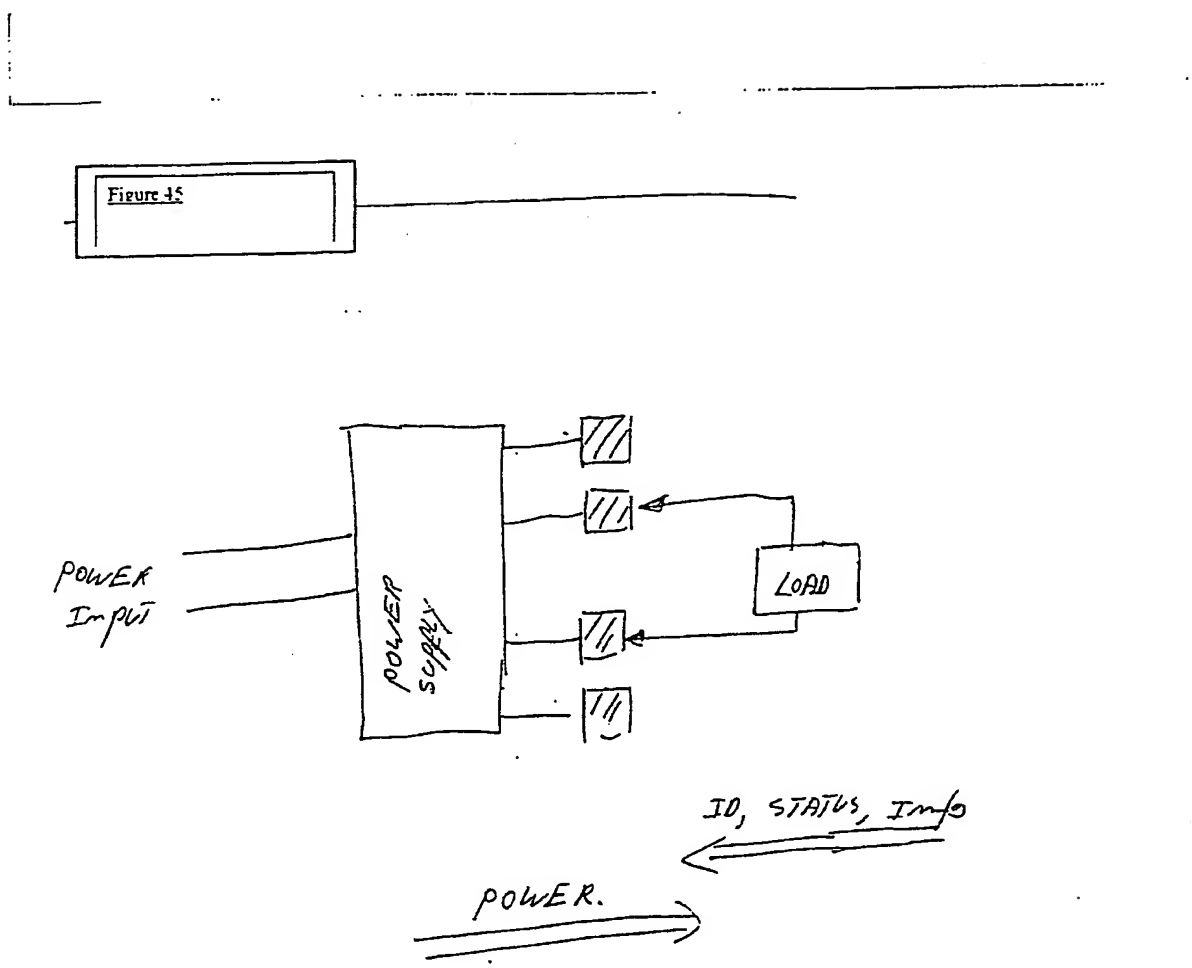


Figure 6:

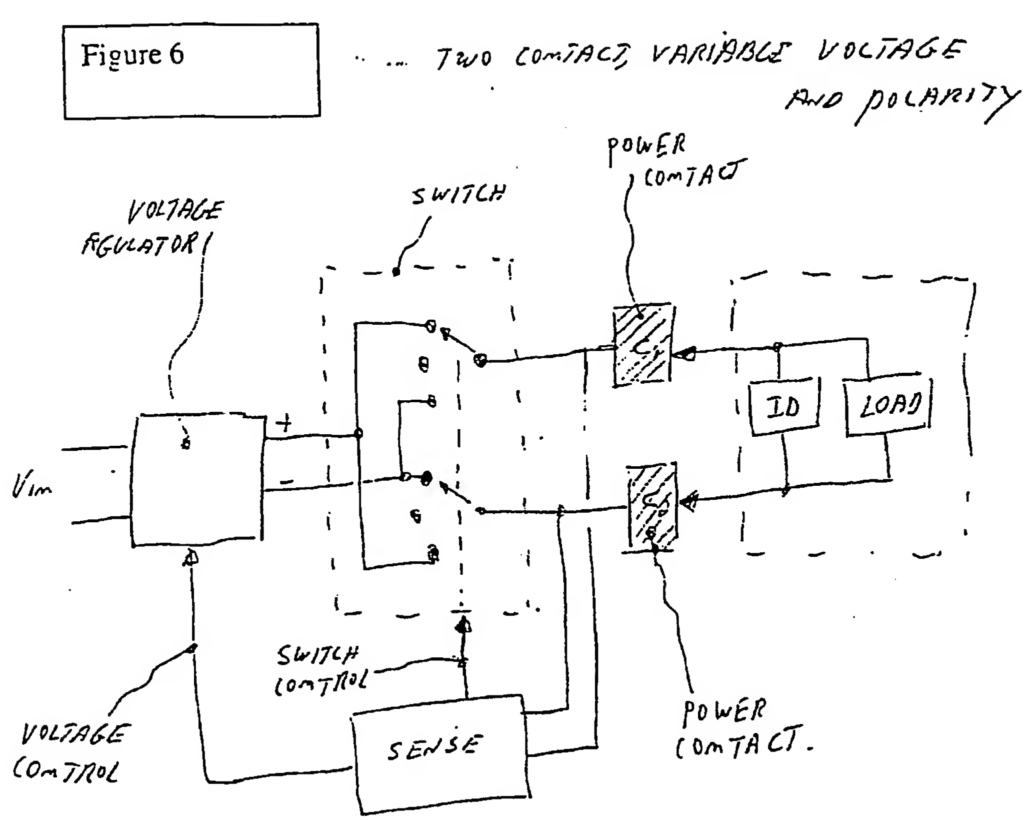


Figure 6
... TWO CONTACT, VARIABLE VOLTAGE AND POLARITY
POWER CONTACT
SWITCH
VOLTAGE REGULATOR
+
-
V_{in}
C_1
C_2
ID
LOAD
SWITCH CONTROL
SENSE
VOLTAGE CONTROL
POWER CONTACT.

Figure 7:

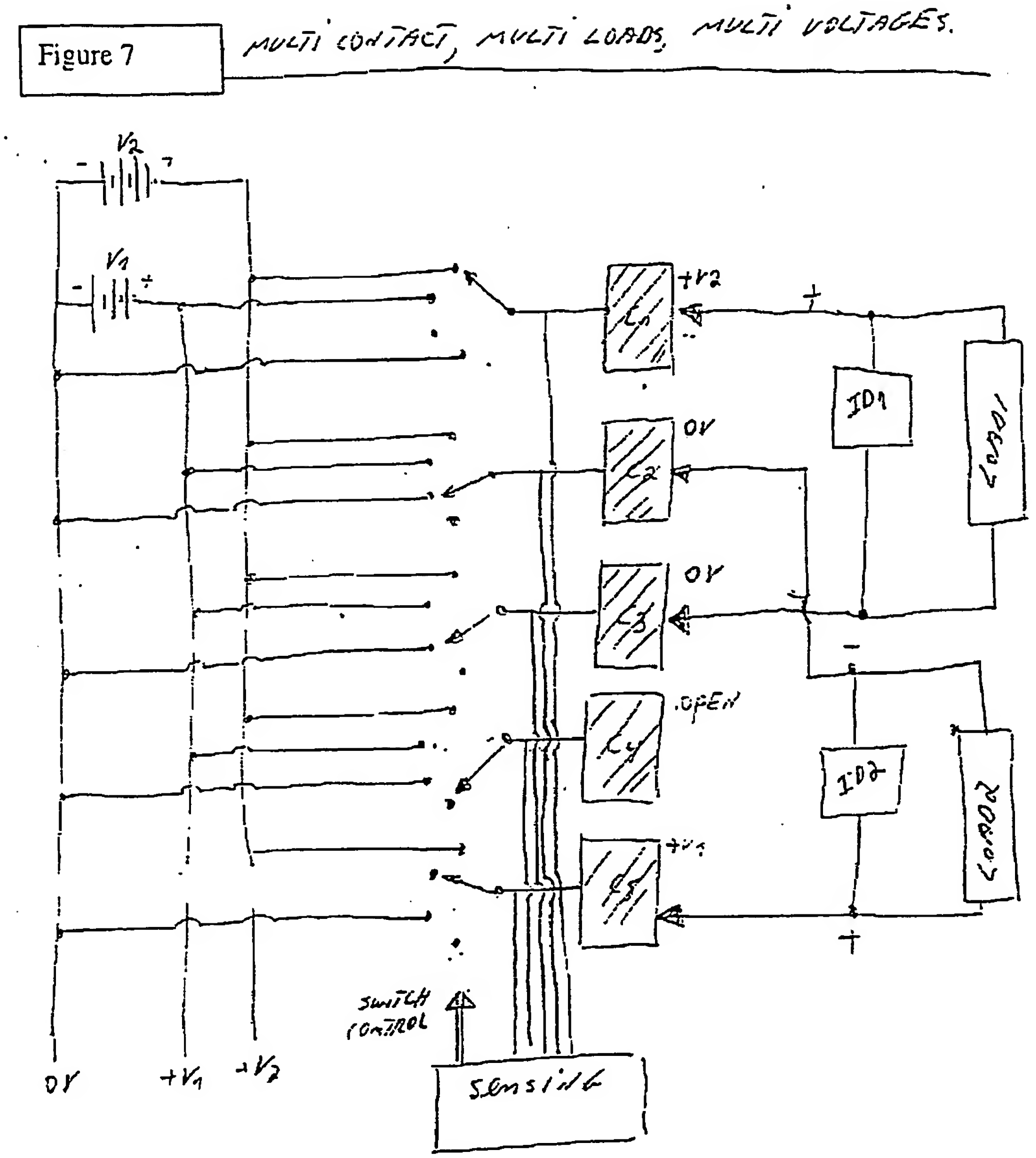


Figure 7
MULTI CONTACT, MULTI LOADS, MULTI VOLTAGES.
V2
V1
+V2
OV
OV
OPEN
+V1
ID1
ID2
LOAD1
LOAD2
SWITCH CONTROL
SENSING
0V
+V1
+V2

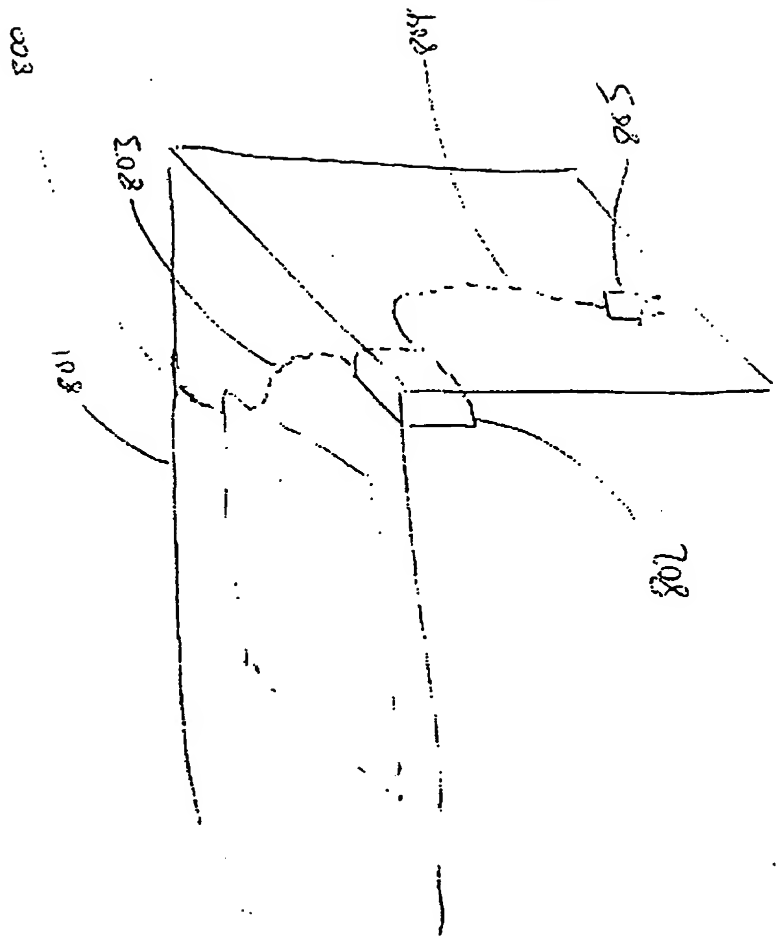


Fig. 8

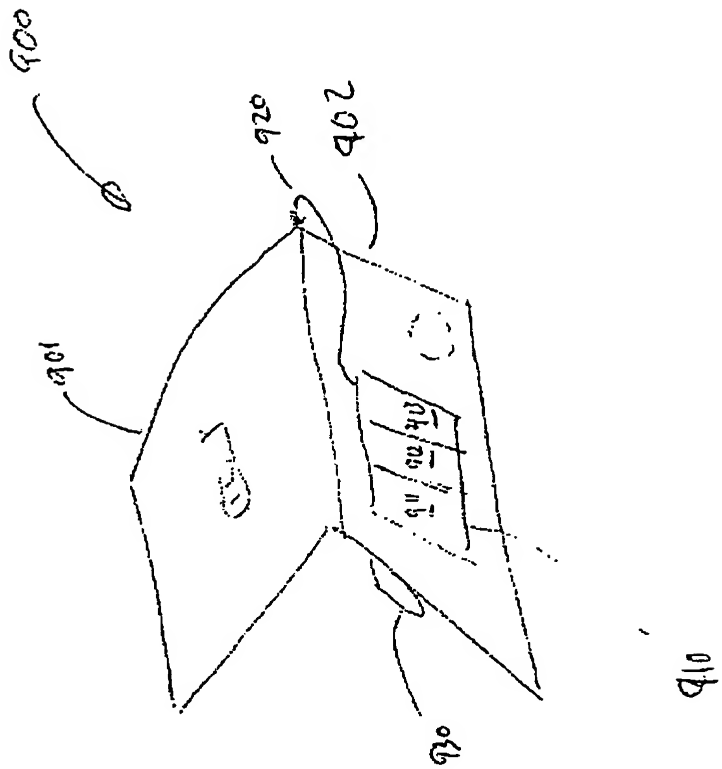


Fig 9

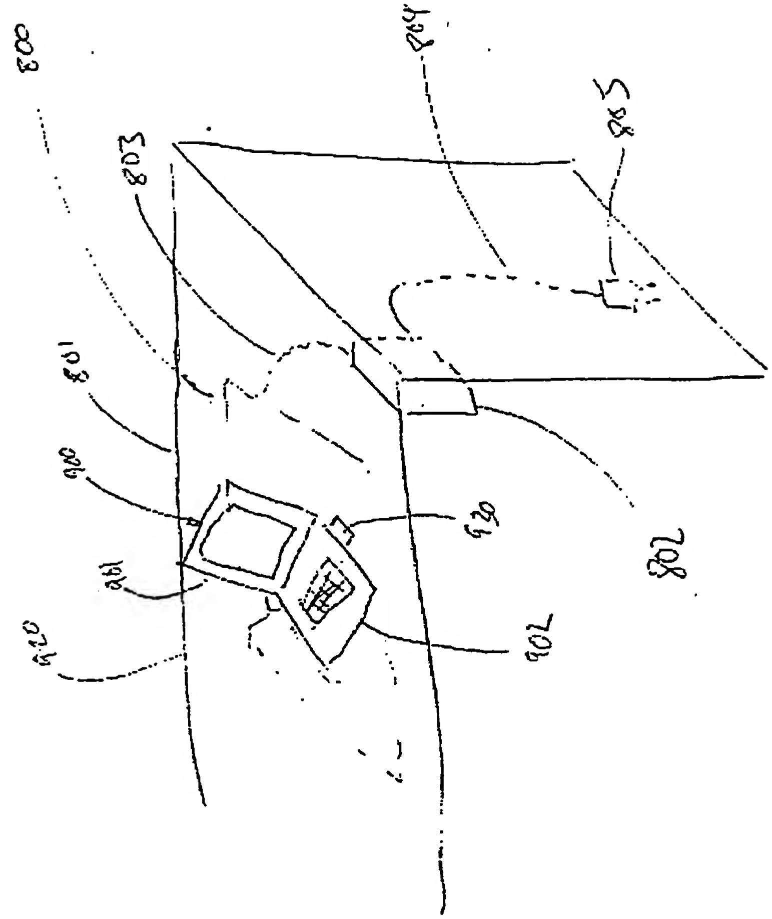


Fig. 10

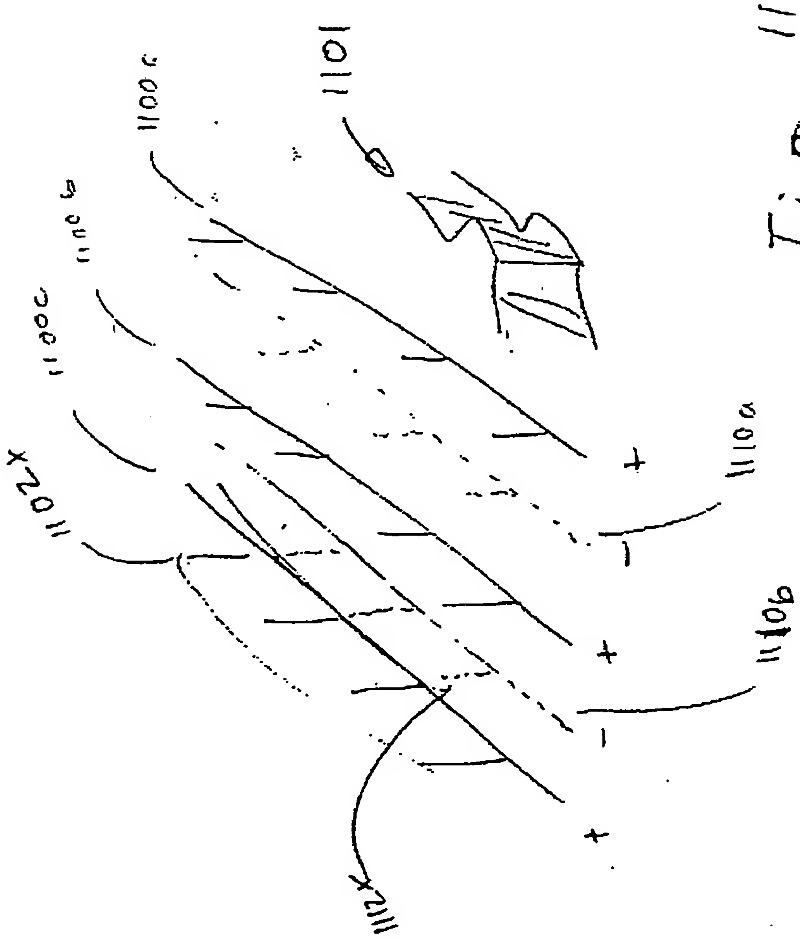


Fig. 11

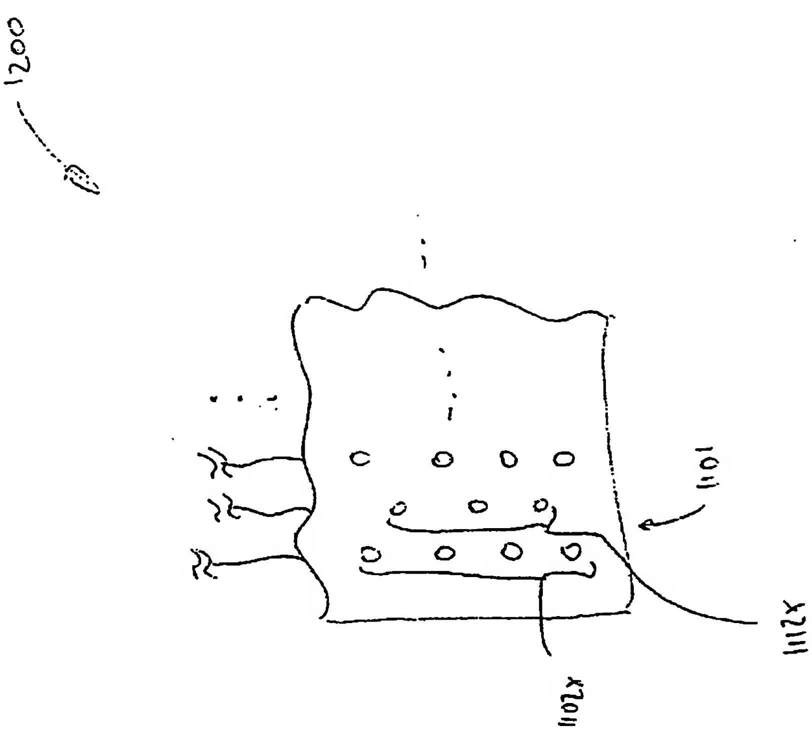


Fig. 17

MWY

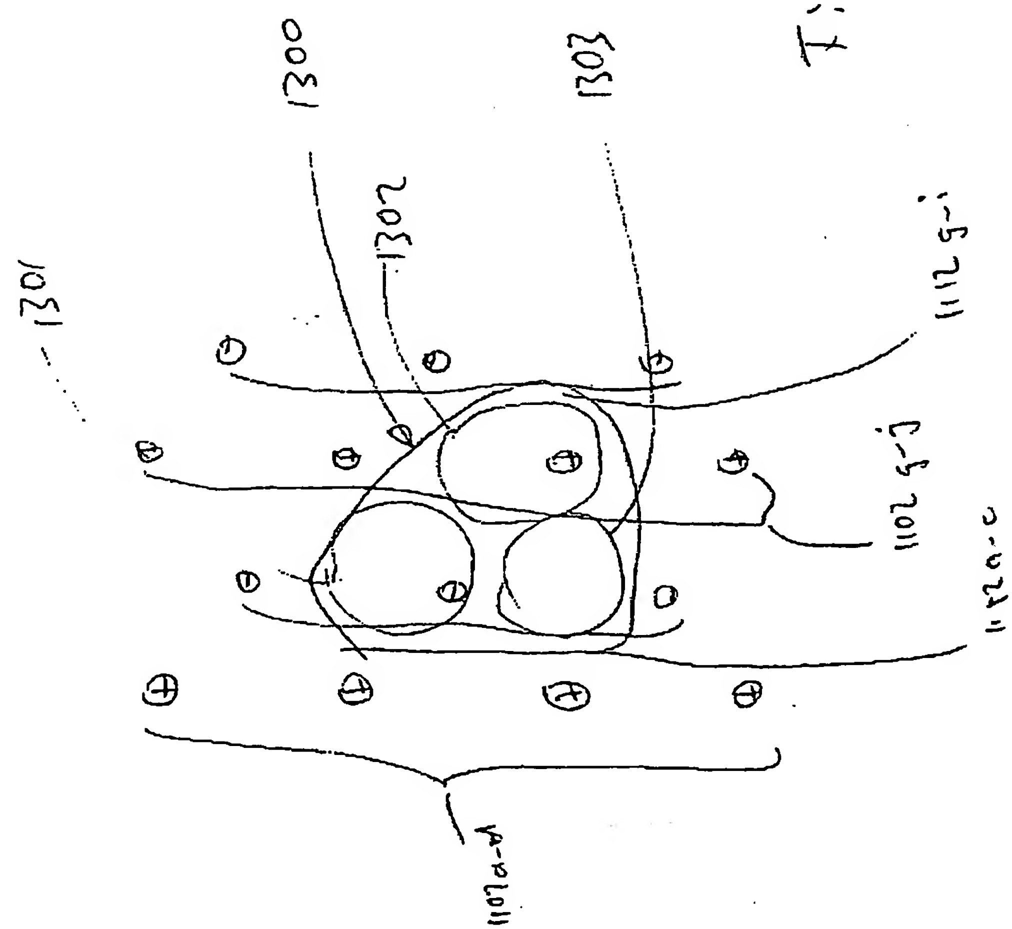


Fig. 13

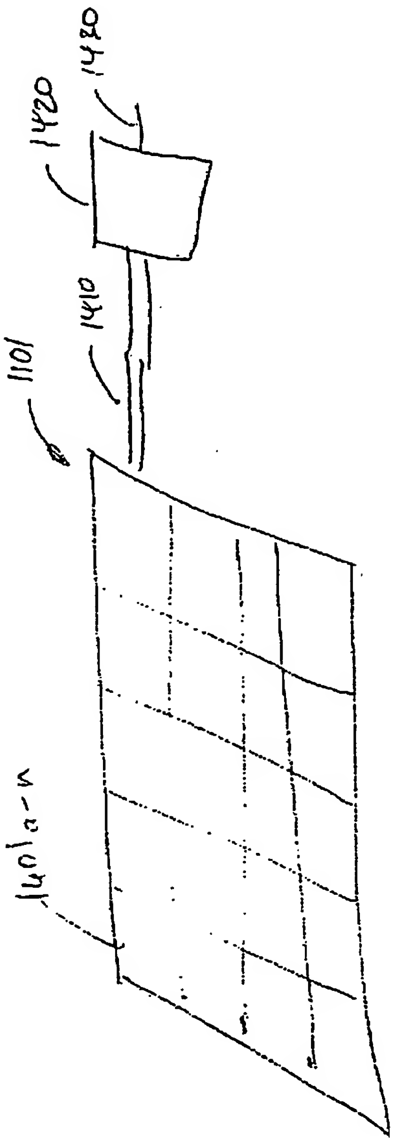


FIG. 14

FIGURE 1 THE THREE LEVELS OF FREEDOM

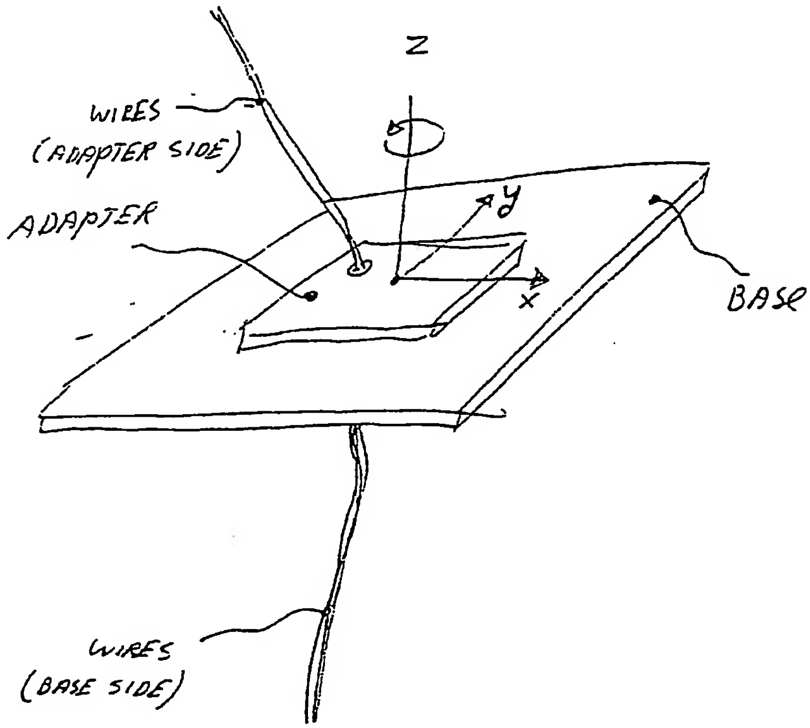


Figure 2:

FIGURE 2 - A CLOSE CIRCUIT THROUGH A1-B1, A2-B2

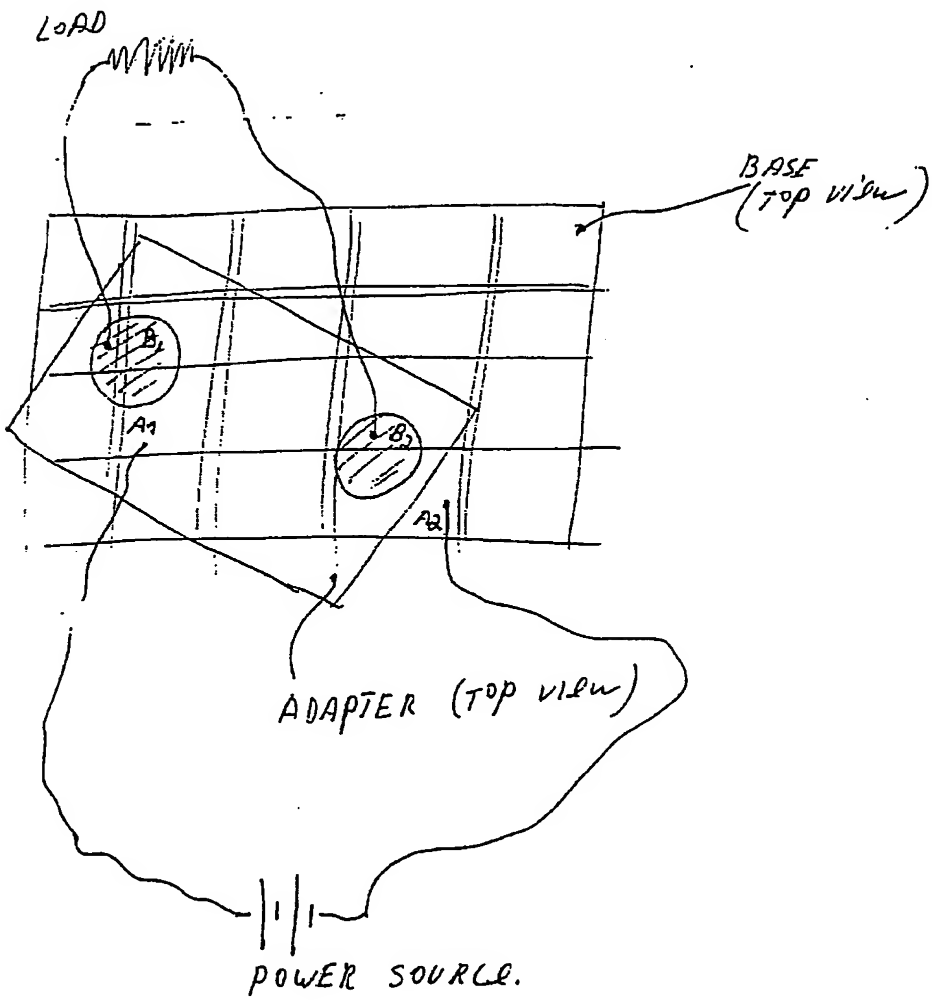


Figure 3:

FIGURE 3 - EXAMPLE 1.

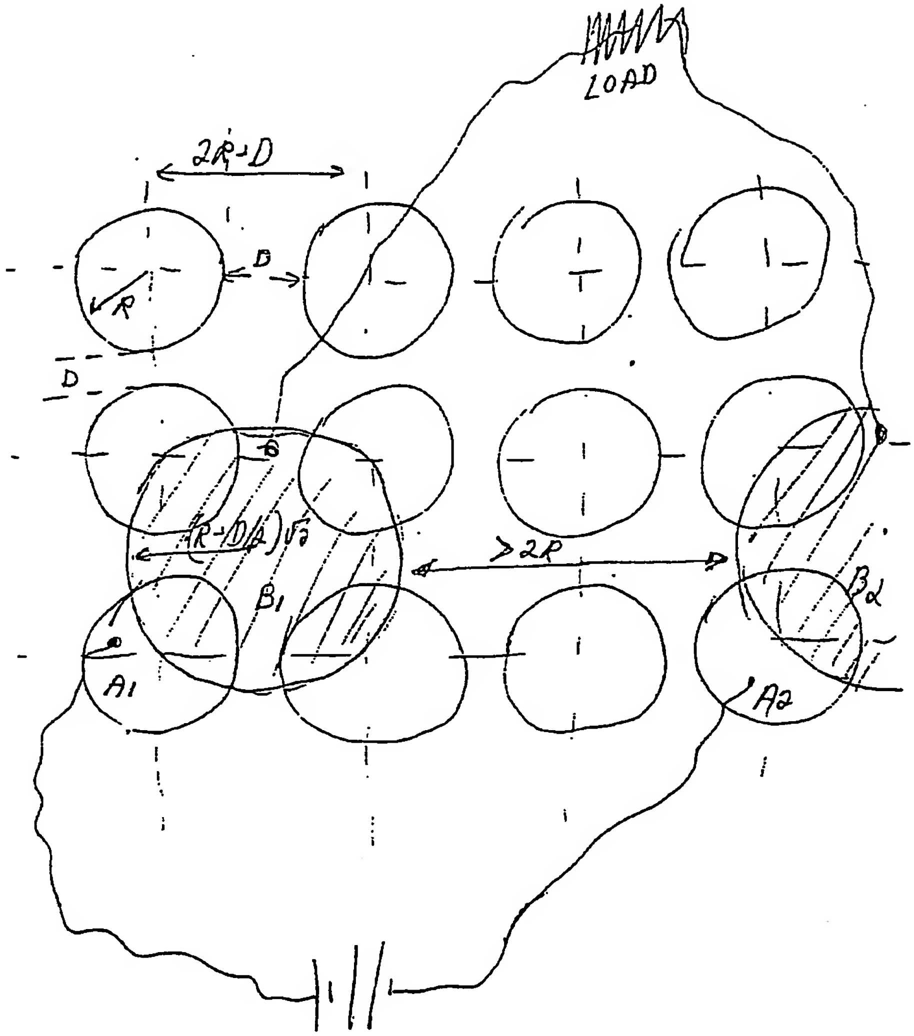
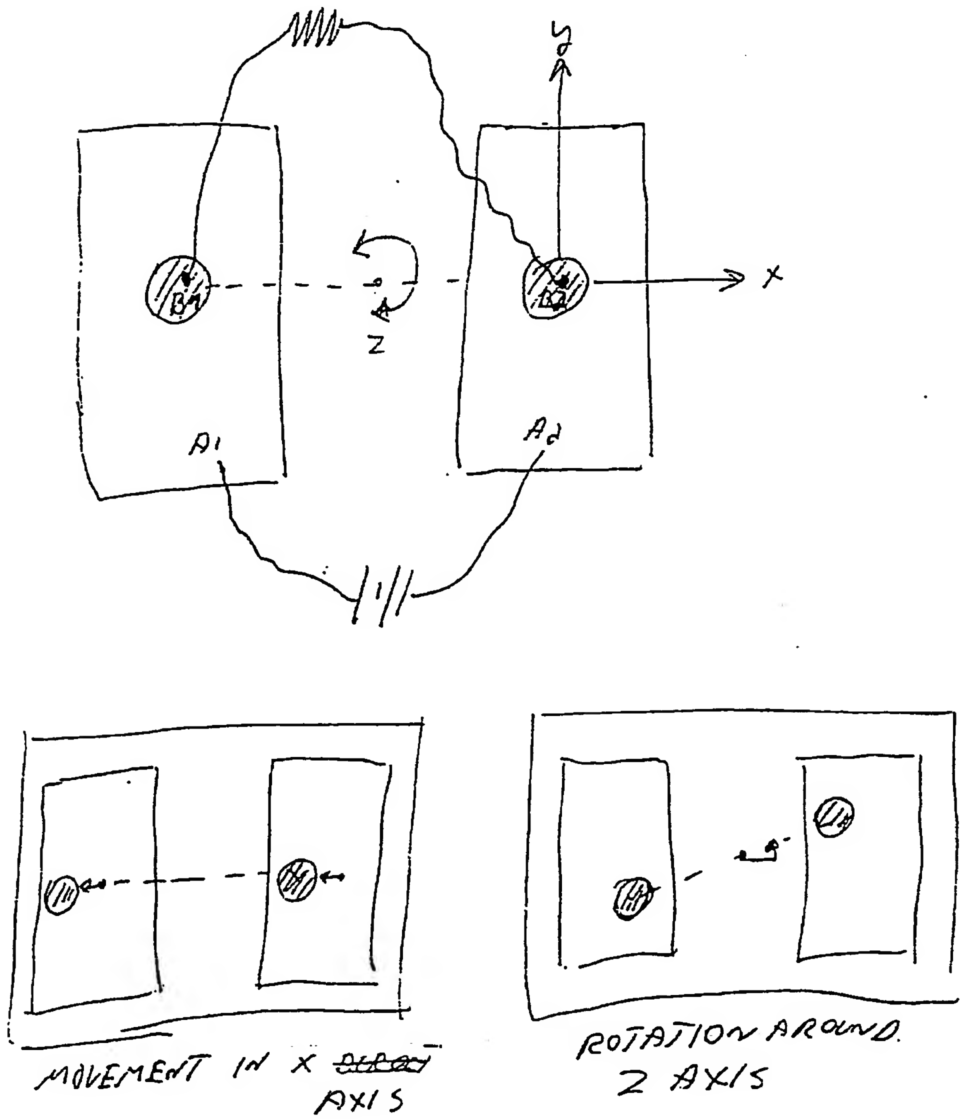


Figure 4:

FIGURE 4 - LIMITED RANGE EXAMPLE



DRAWINGS:

Figure 5:

Figure 45

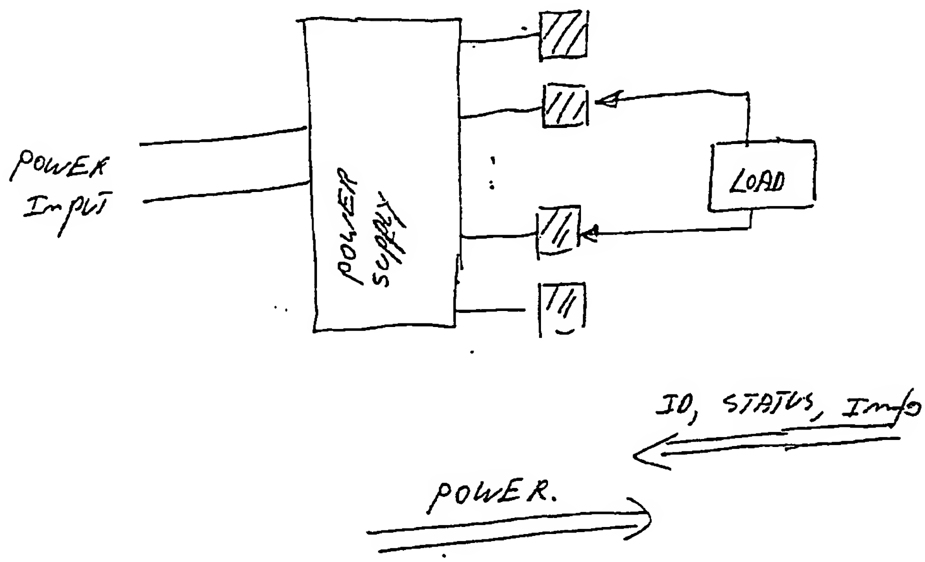


Figure 6:

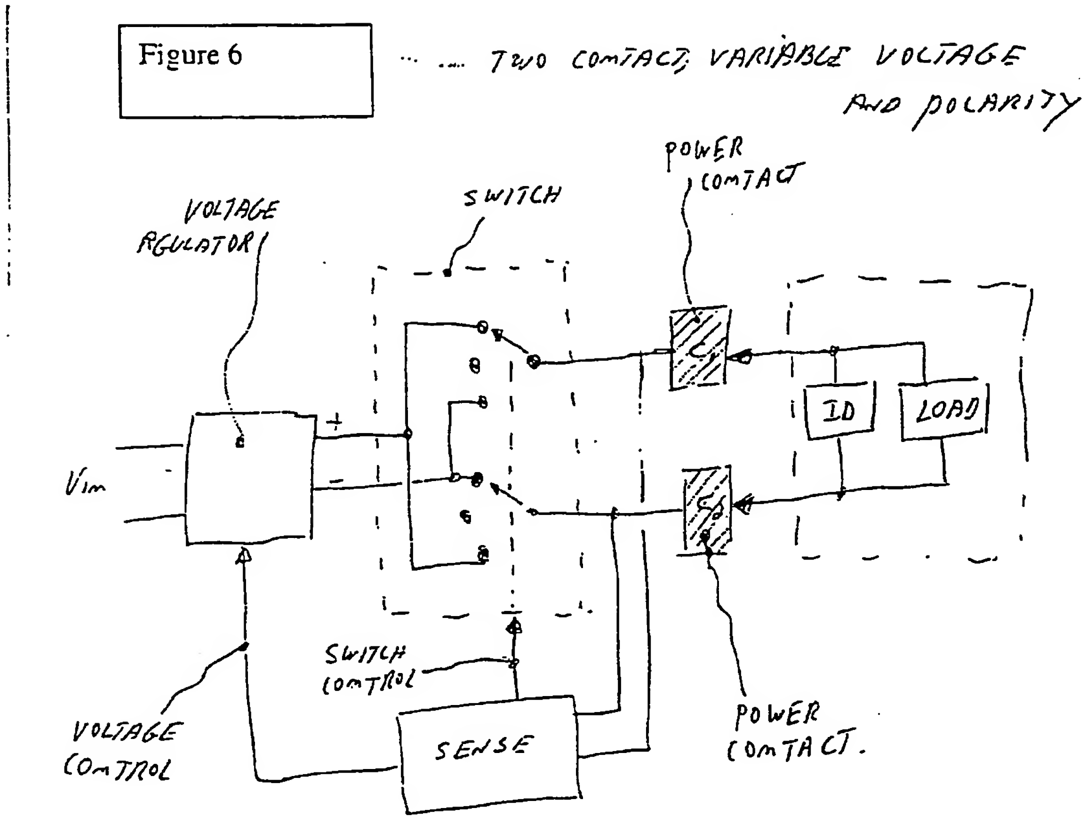
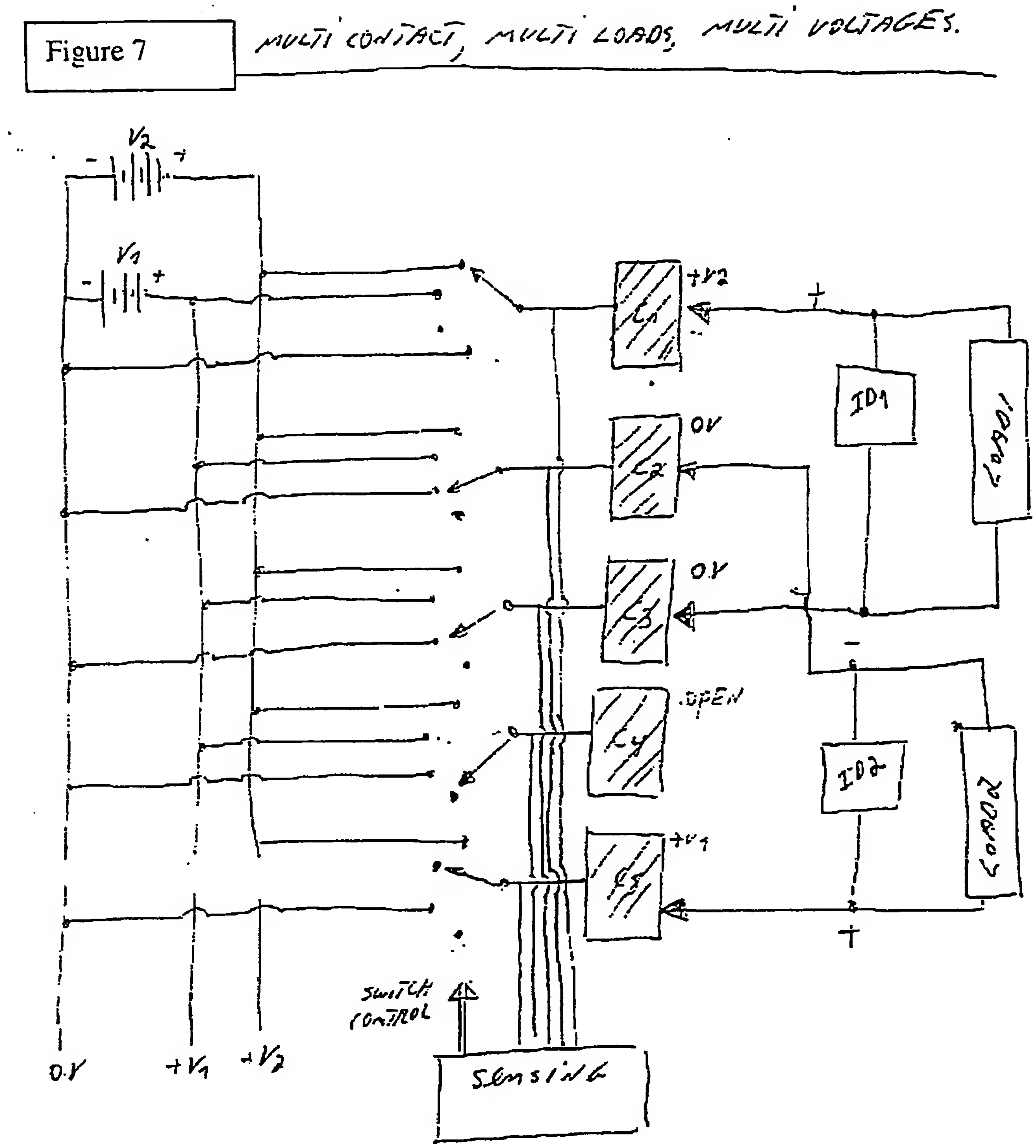


Figure 6
TWO CONTACT; VARIABLE VOLTAGE AND POLARITY
POWER CONTACT
SWITCH
VOLTAGE REGULATOR
+
−
V_{in}
C_1
C_2
ID
LOAD
SWITCH CONTROL
SENSE
VOLTAGE CONTROL
POWER CONTACT.

Figure 7:

Figure 7



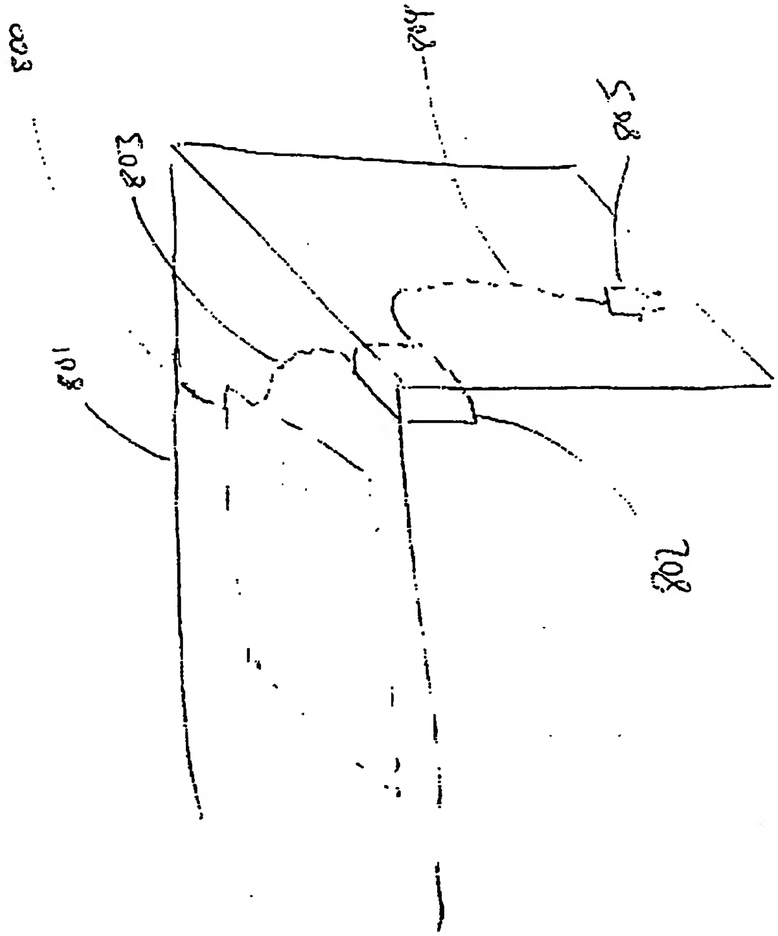


Fig. 8

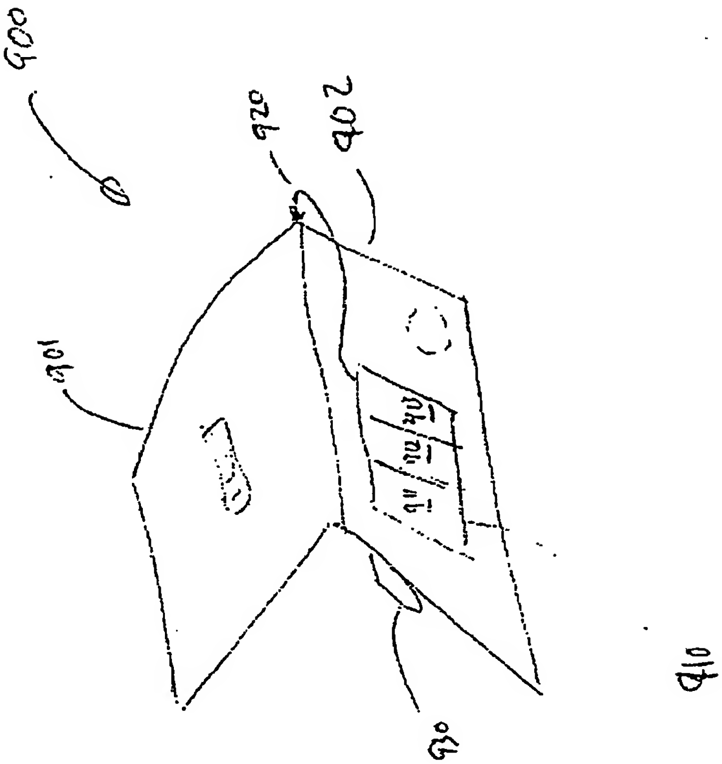


Fig 9

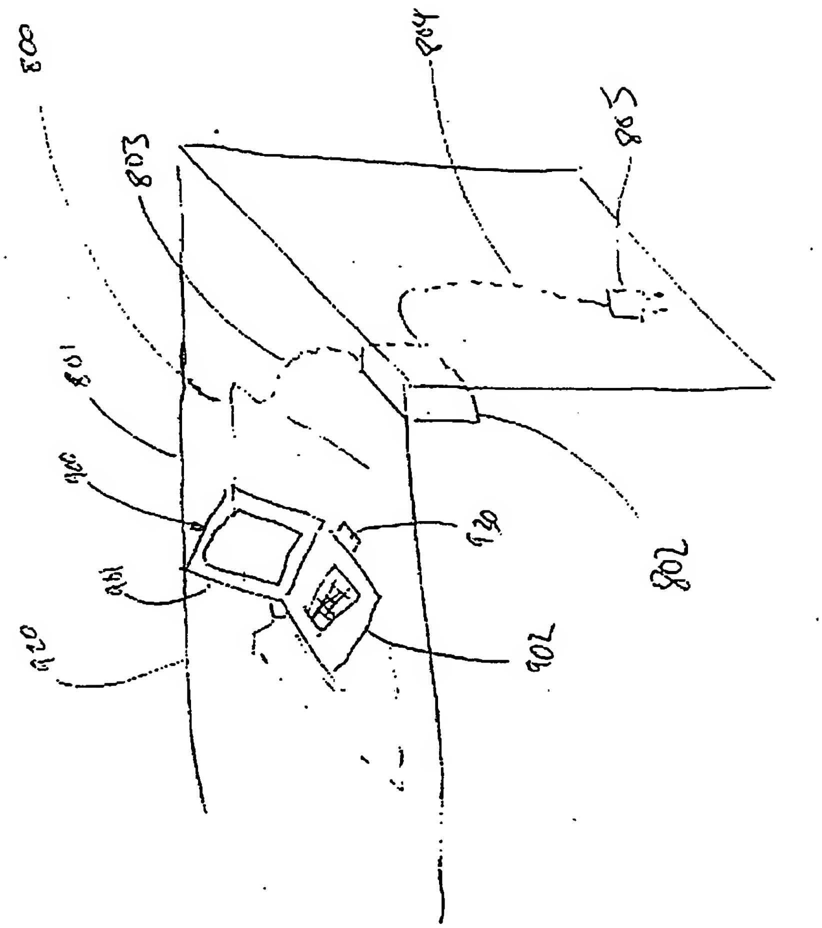


Fig. 10

MW4

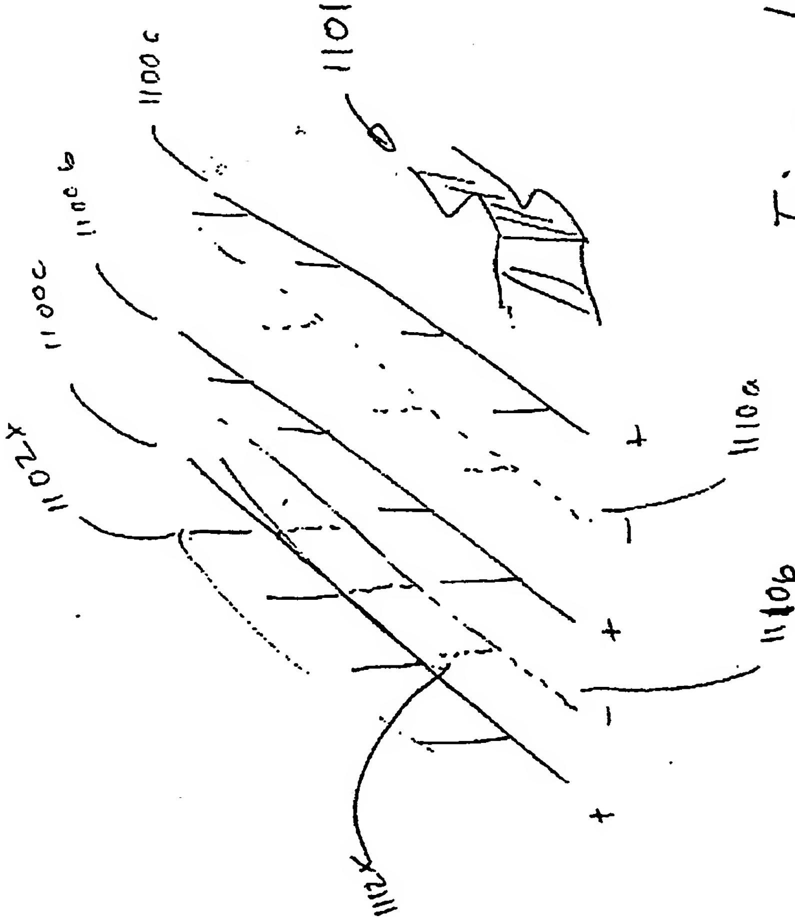


Fig. 11

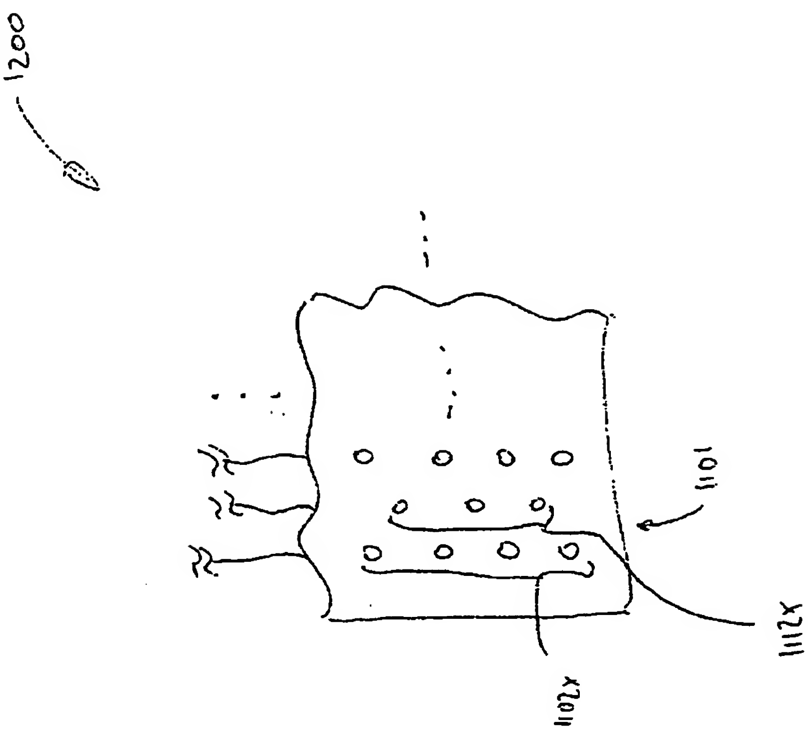


Fig. 17

MWY

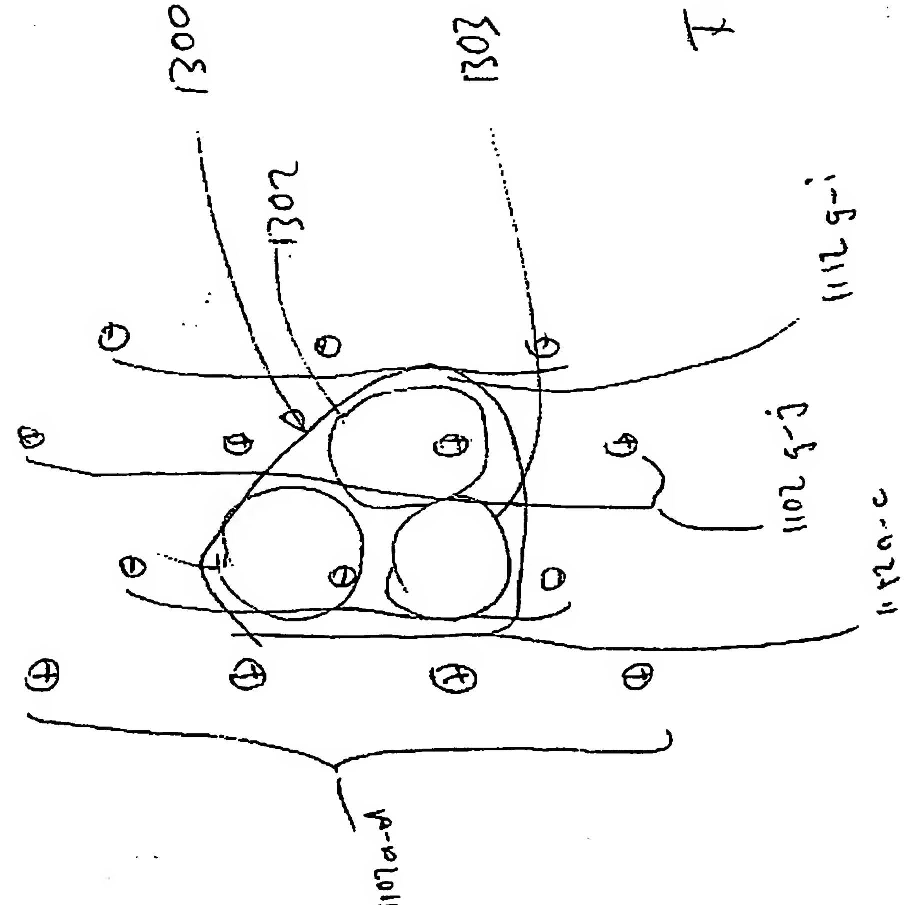


Fig. 13

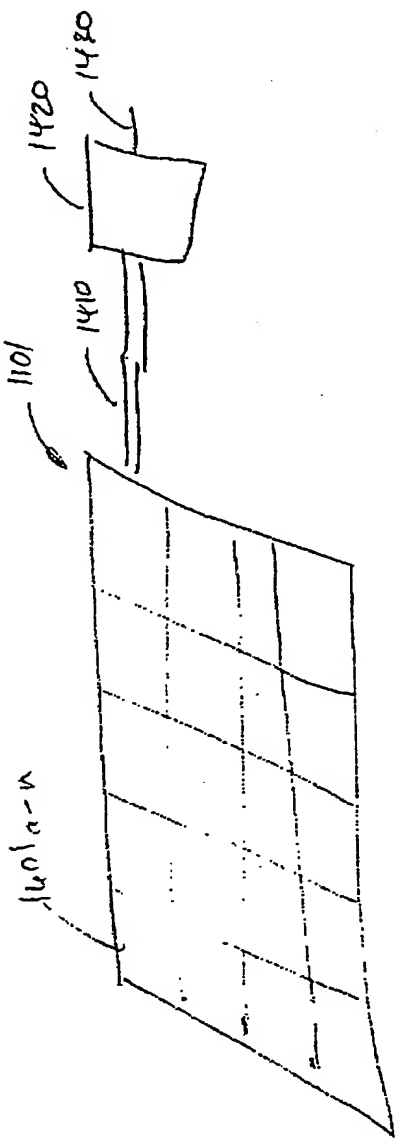


FIG. 14

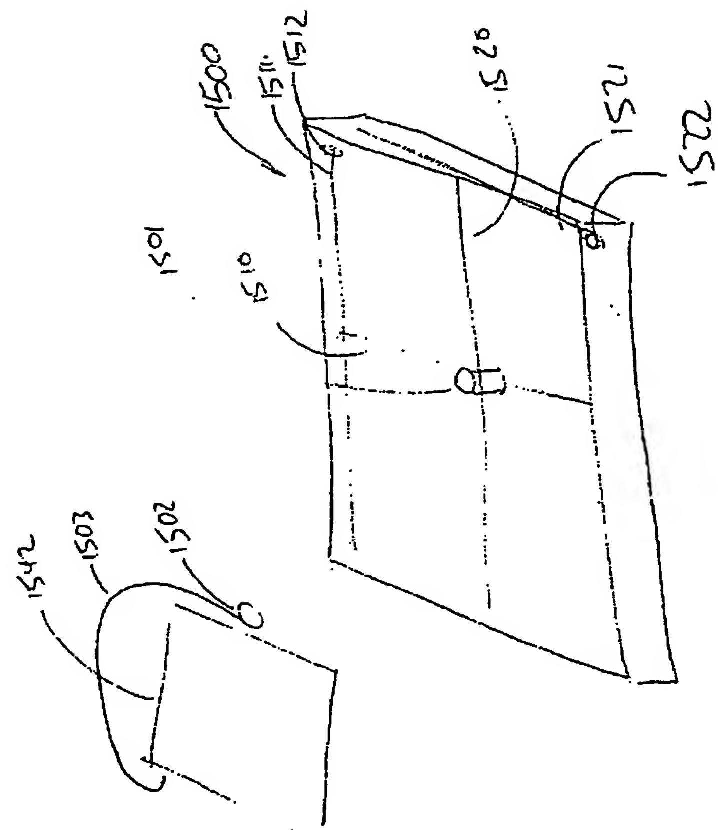


Fig. 15

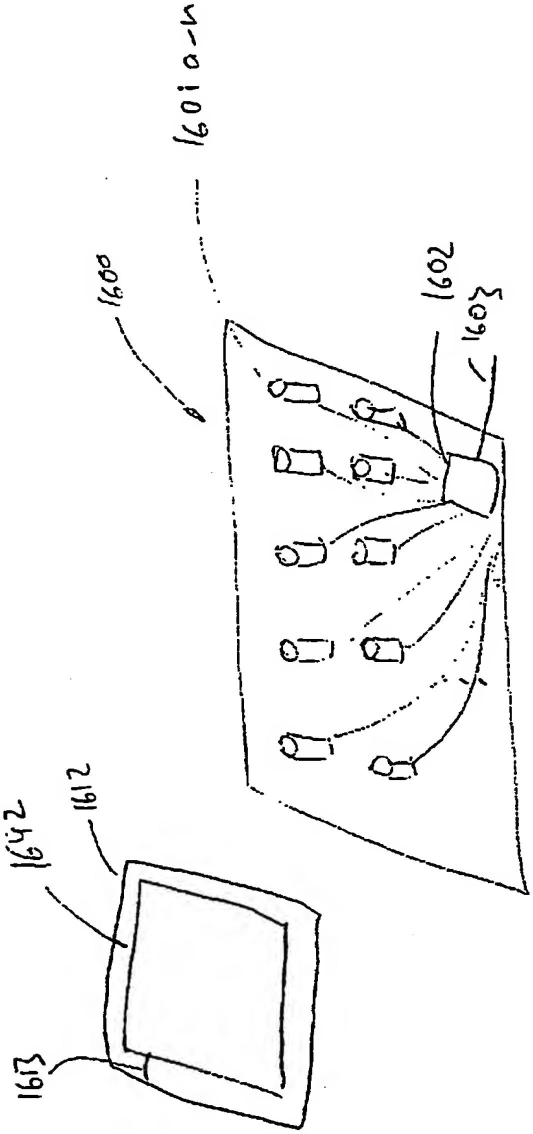


Fig. 16

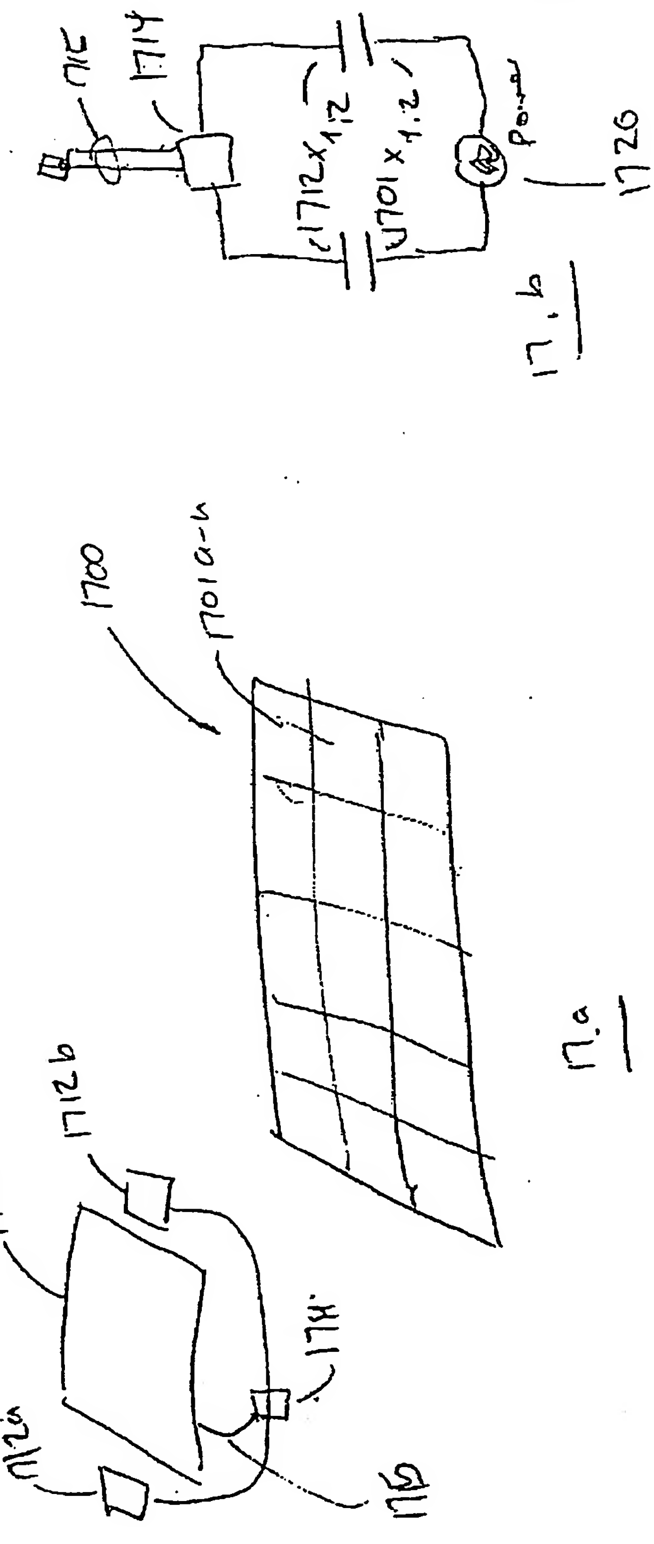

1714
1712 x1,2
1701 x1,2
Power
1726
17.b
1700
1701a-h
17.a
1742
1712b
1712a
1716

Fig. 17

MJS

MWS

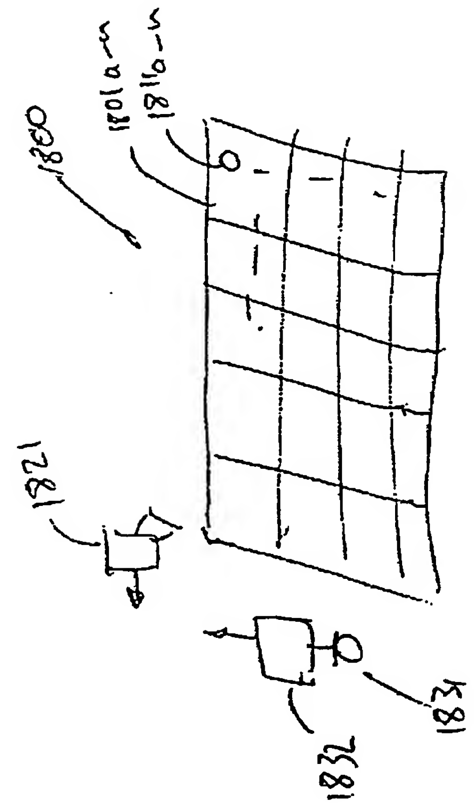


Fig 18

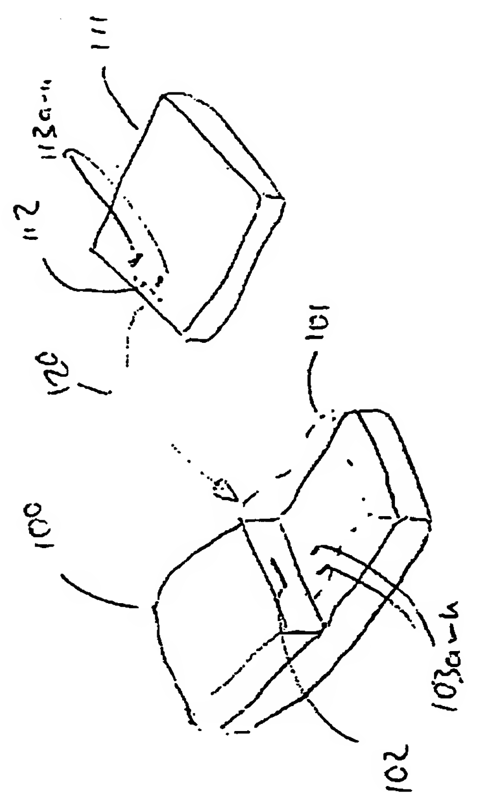


Fig. 1

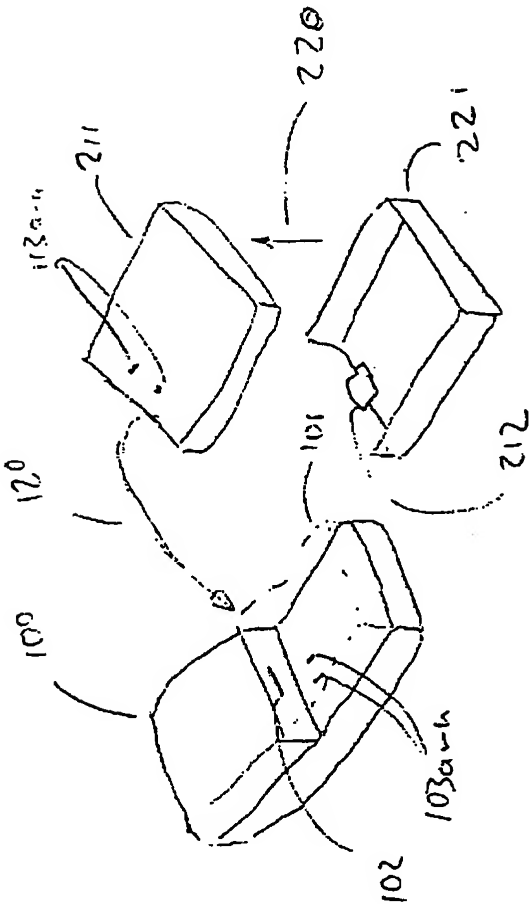


Fig. 7

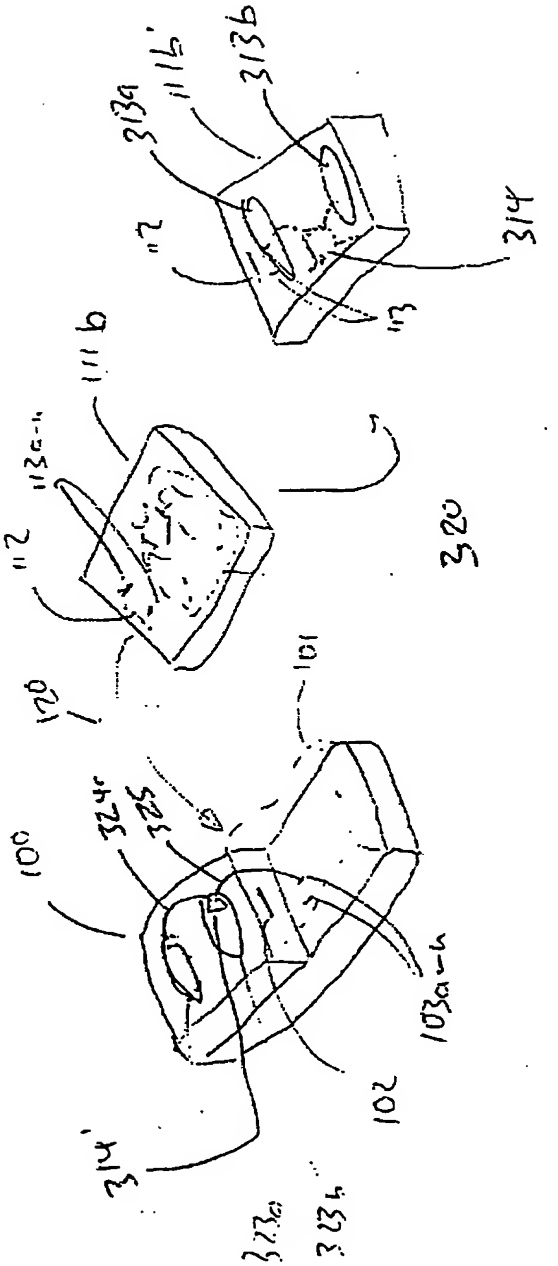


Fig. 3

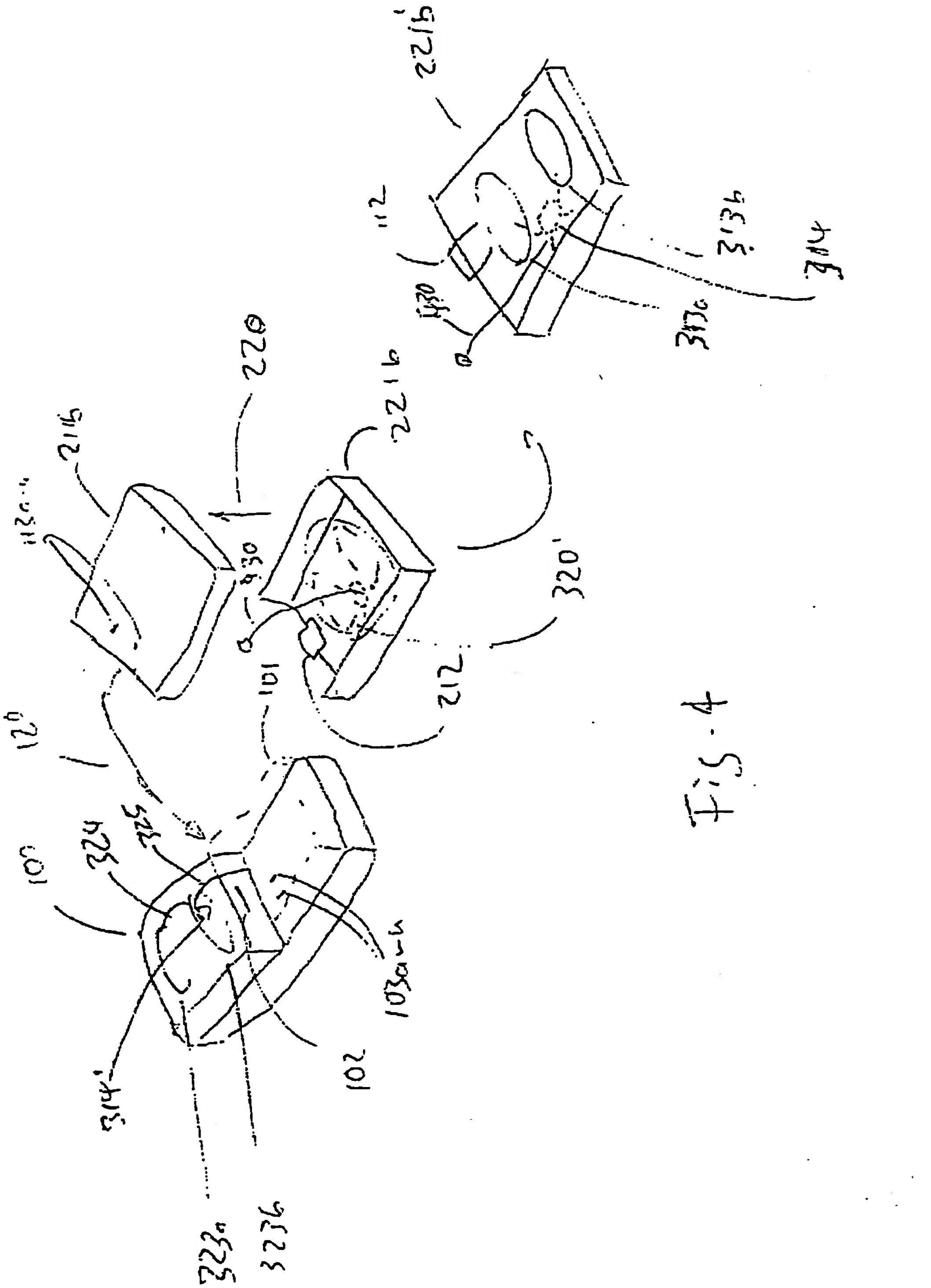


Fig. 4

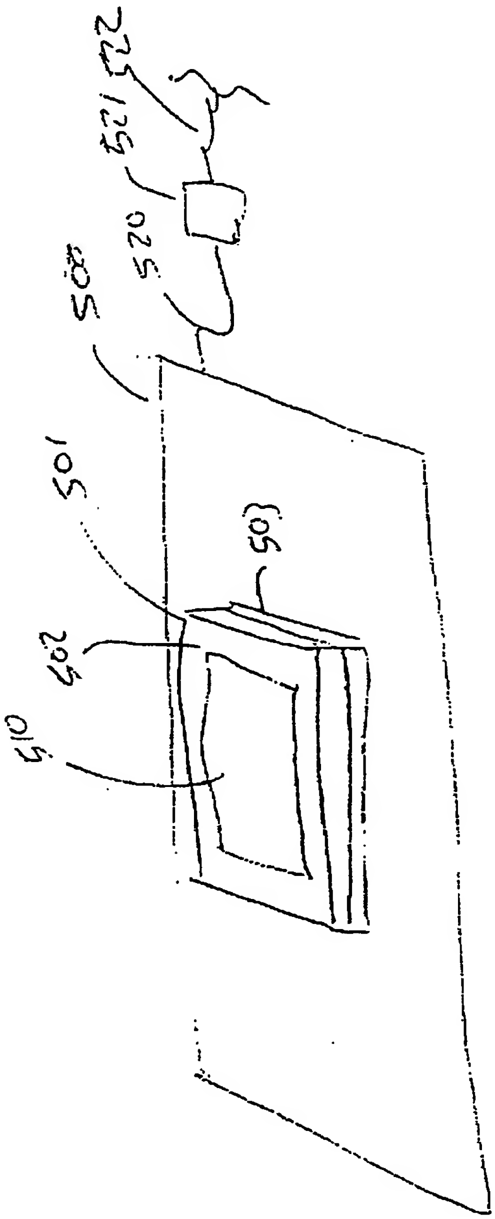


Fig. 5

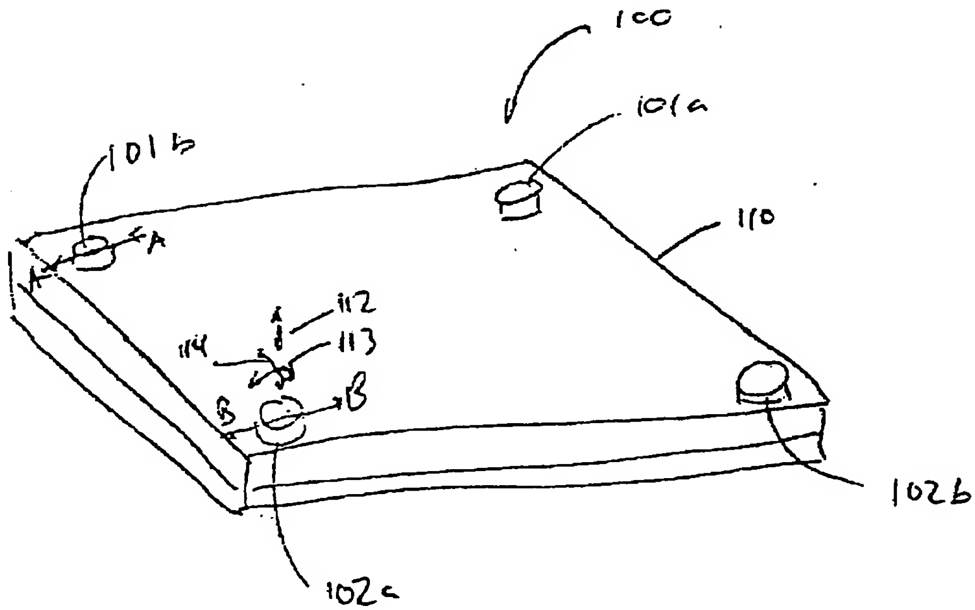


Fig. 1

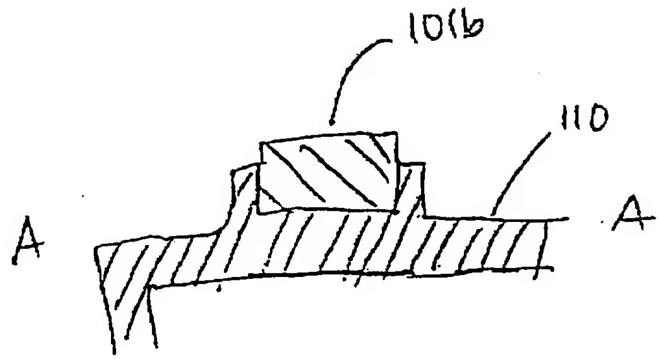


Fig. 2

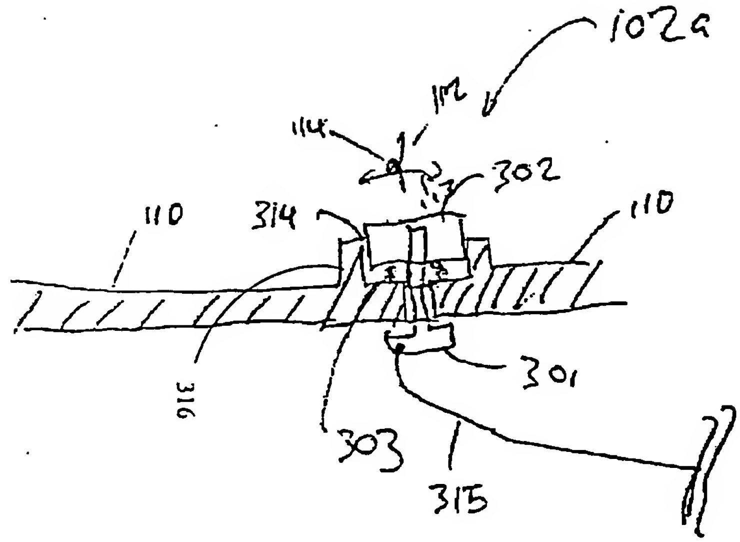


Fig 3

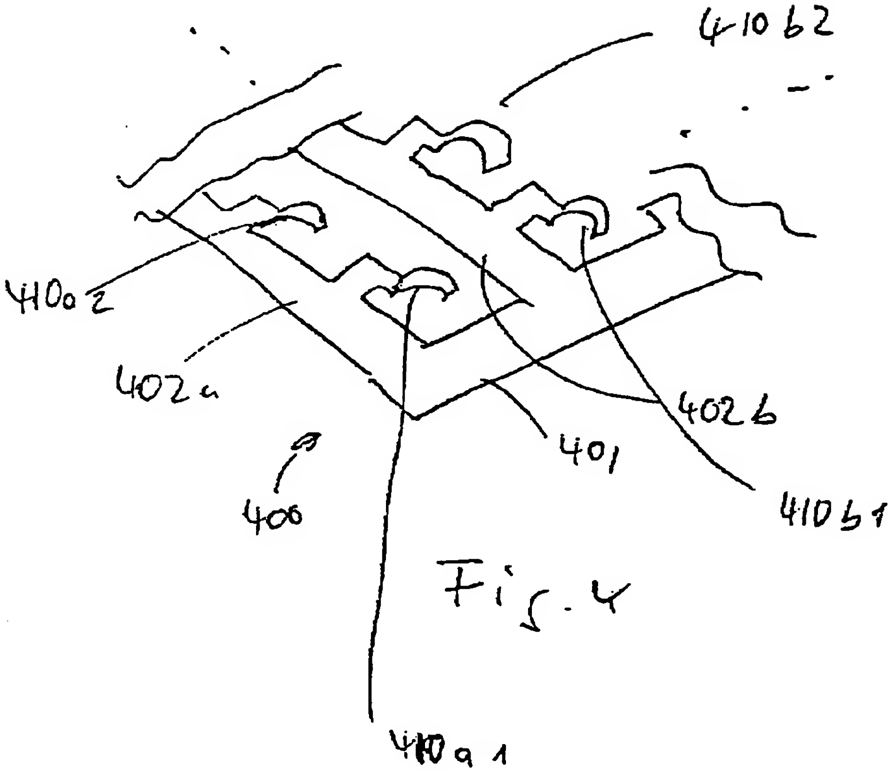


Fig. 4

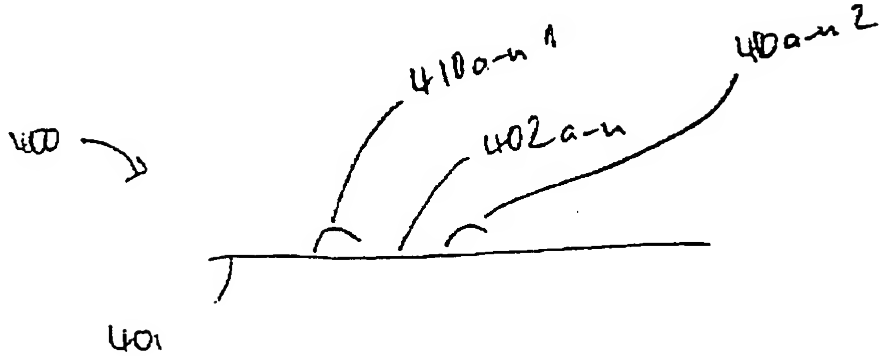


Fig. 5

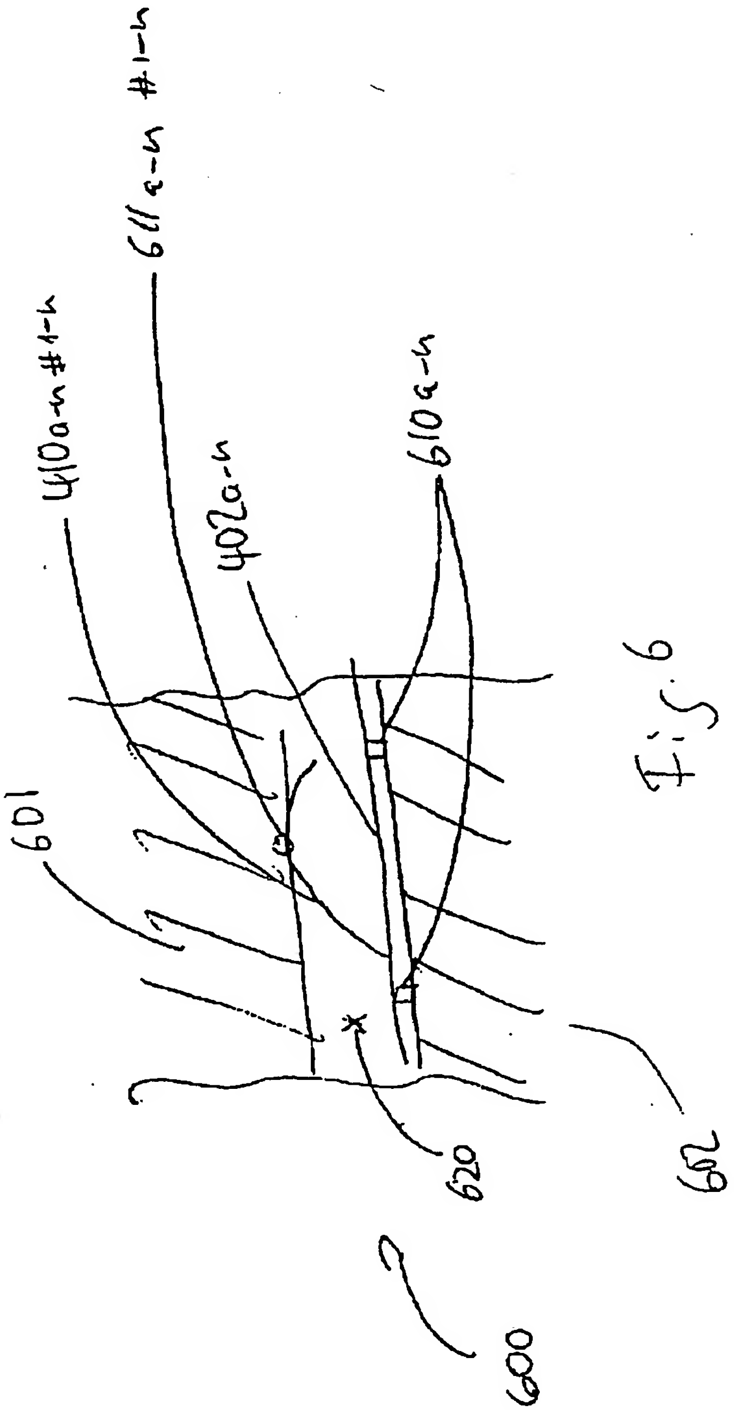


Fig. 6

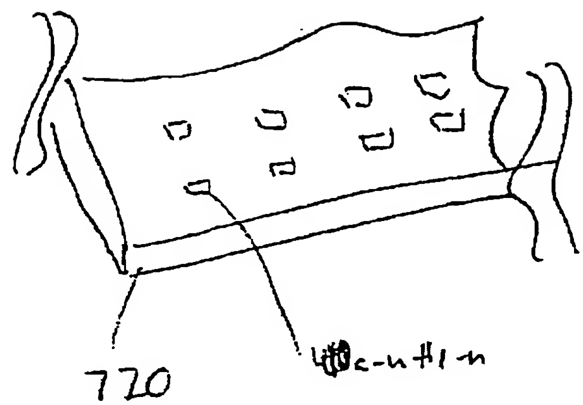


Fig 7

Figure 8b

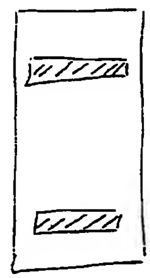
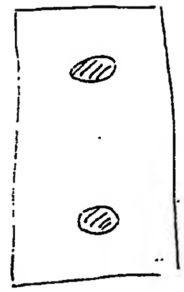


Figure 8a



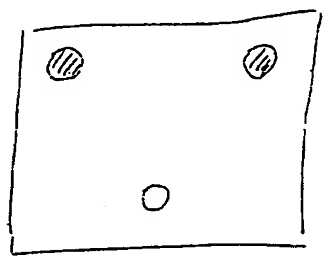


Figure 8c

Figure 8

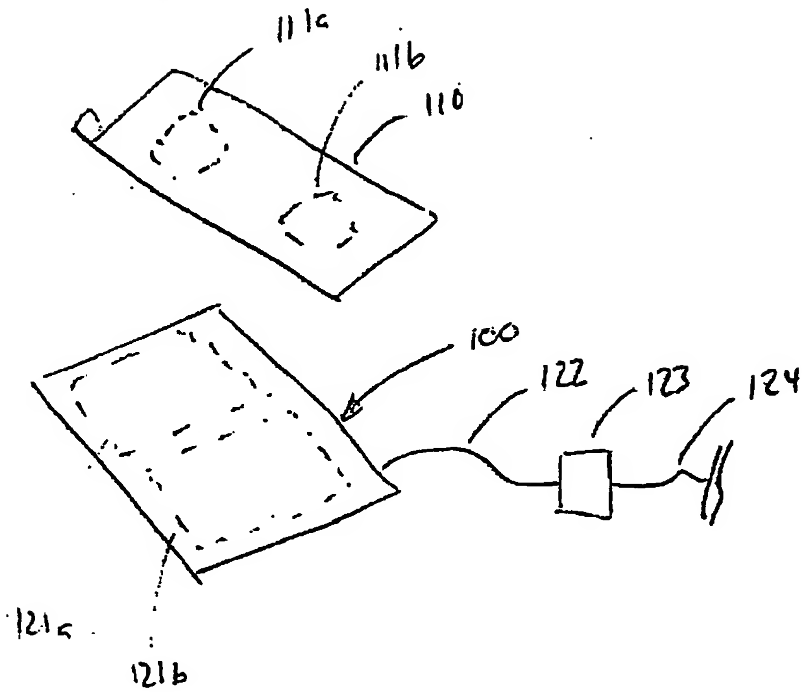


Fig. 1

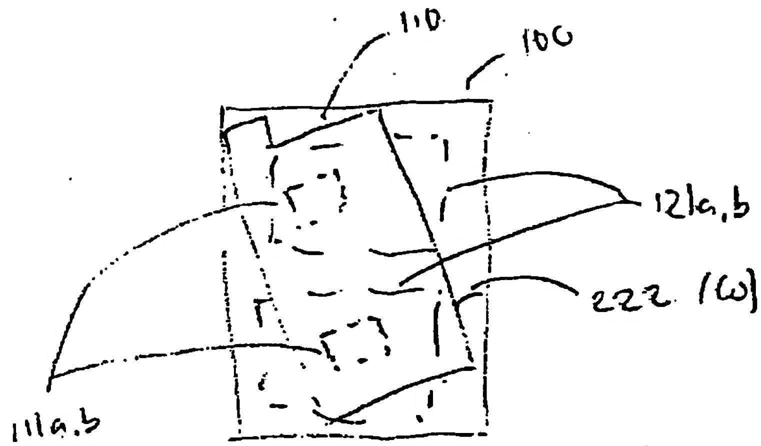


Fig. 2.

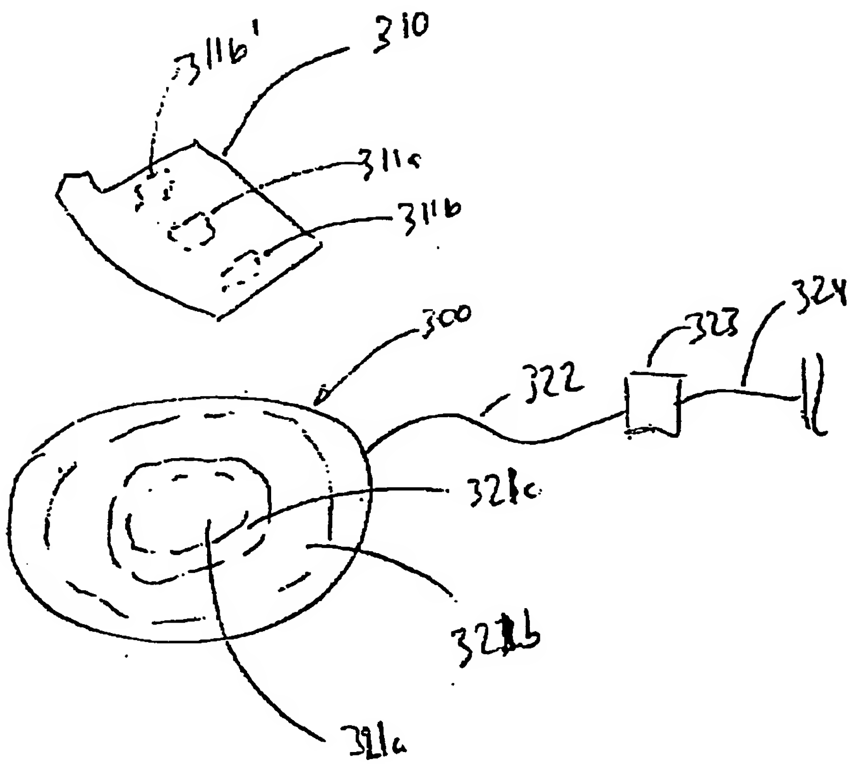


Fig. 3

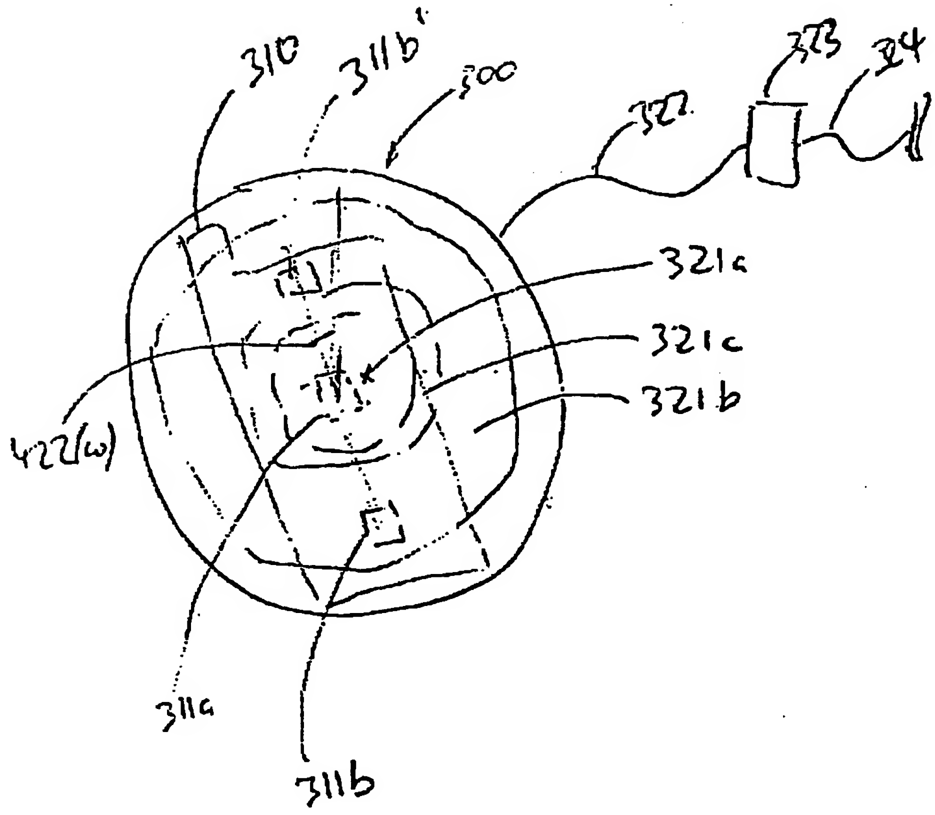


Fig 4.

FIGURE 1 THE THREE LEVELS OF FREEDOM

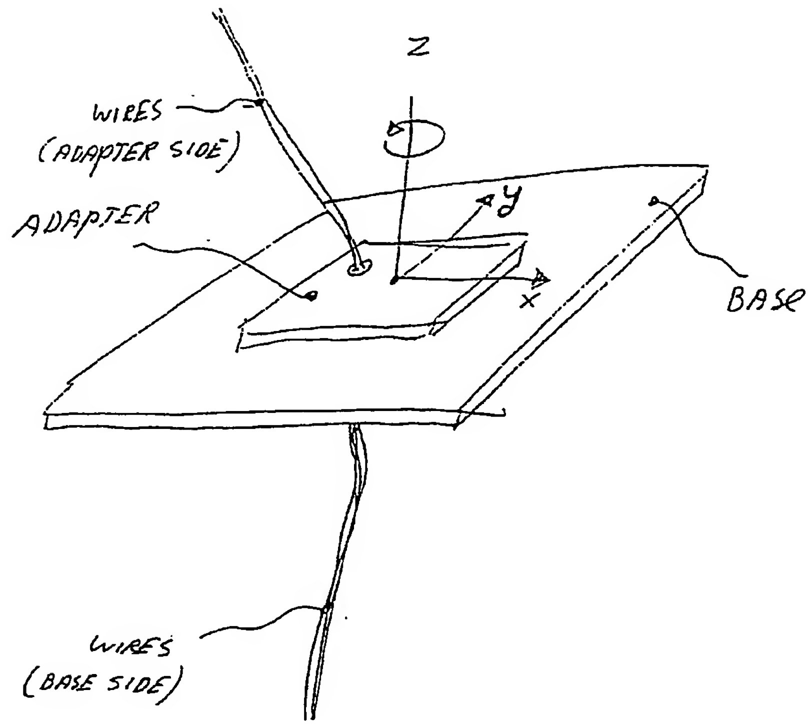


Figure 2:

FIGURE 2 - A CLOSE CIRCUIT THROUGH A1-B1, A2-B2

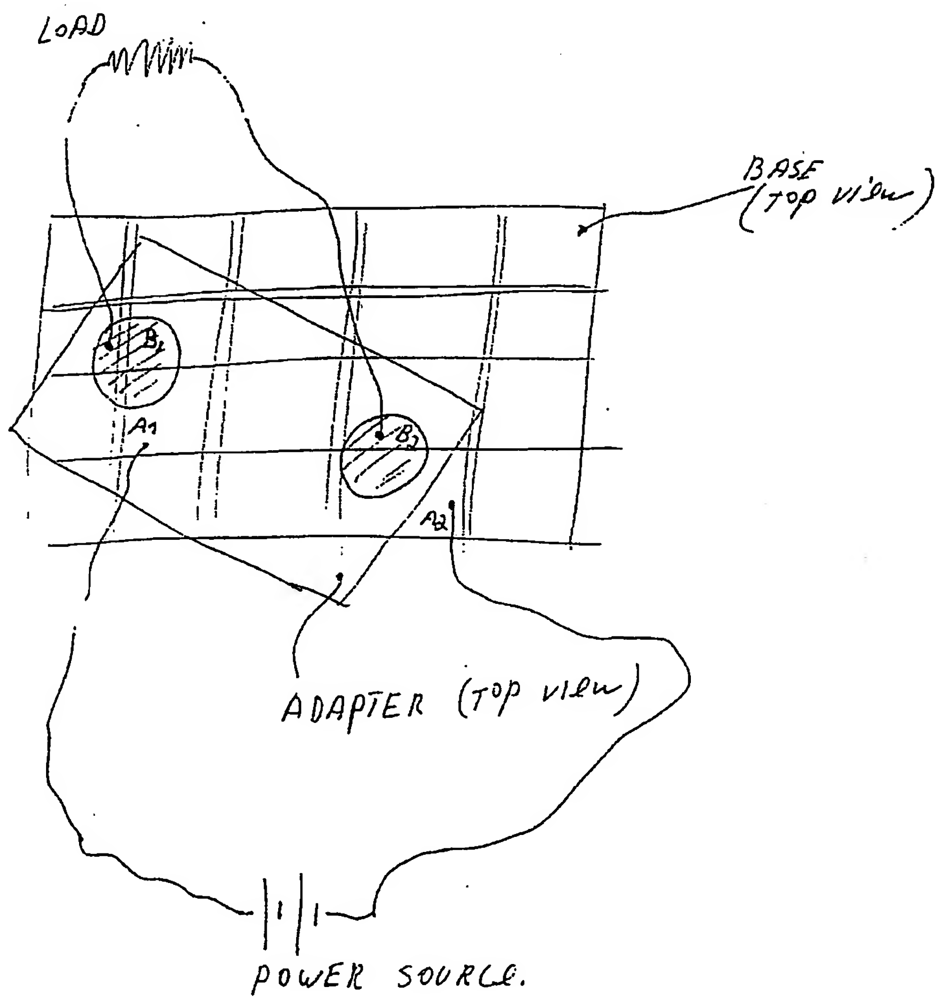


Figure 3:

FIGURE 3 - EXAMPLE 1.

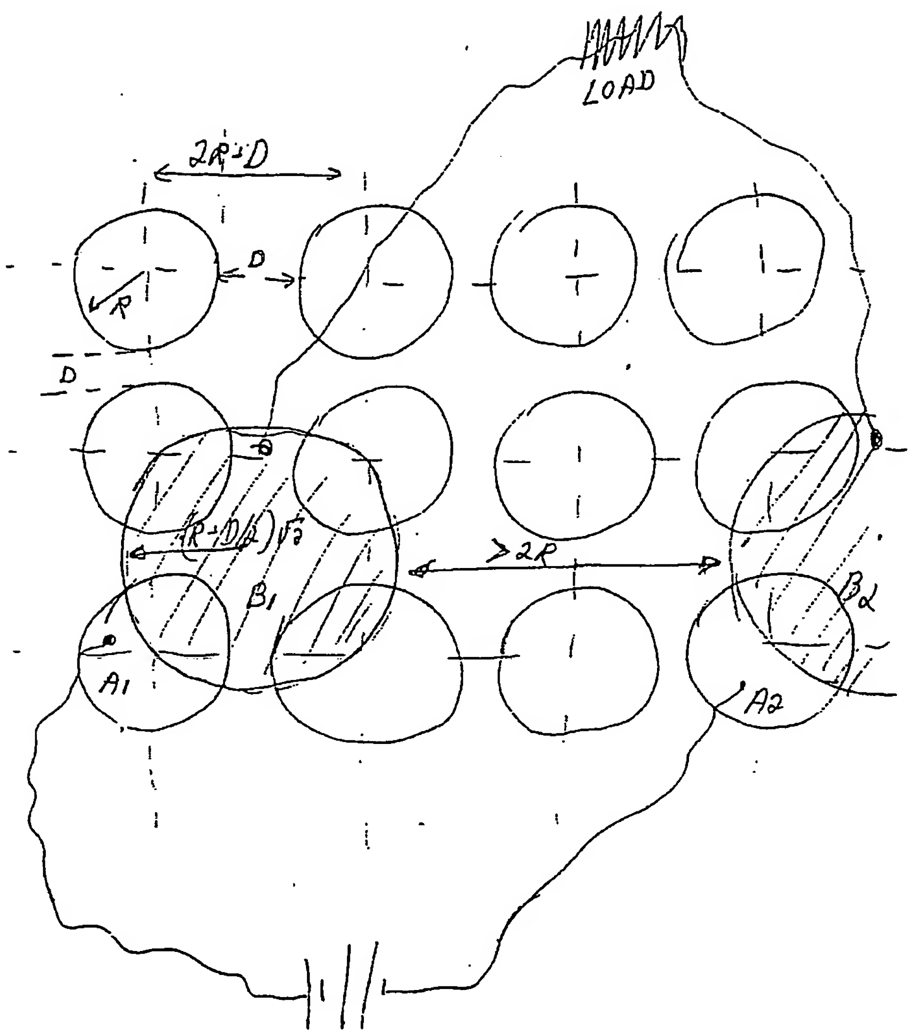


Figure 4:

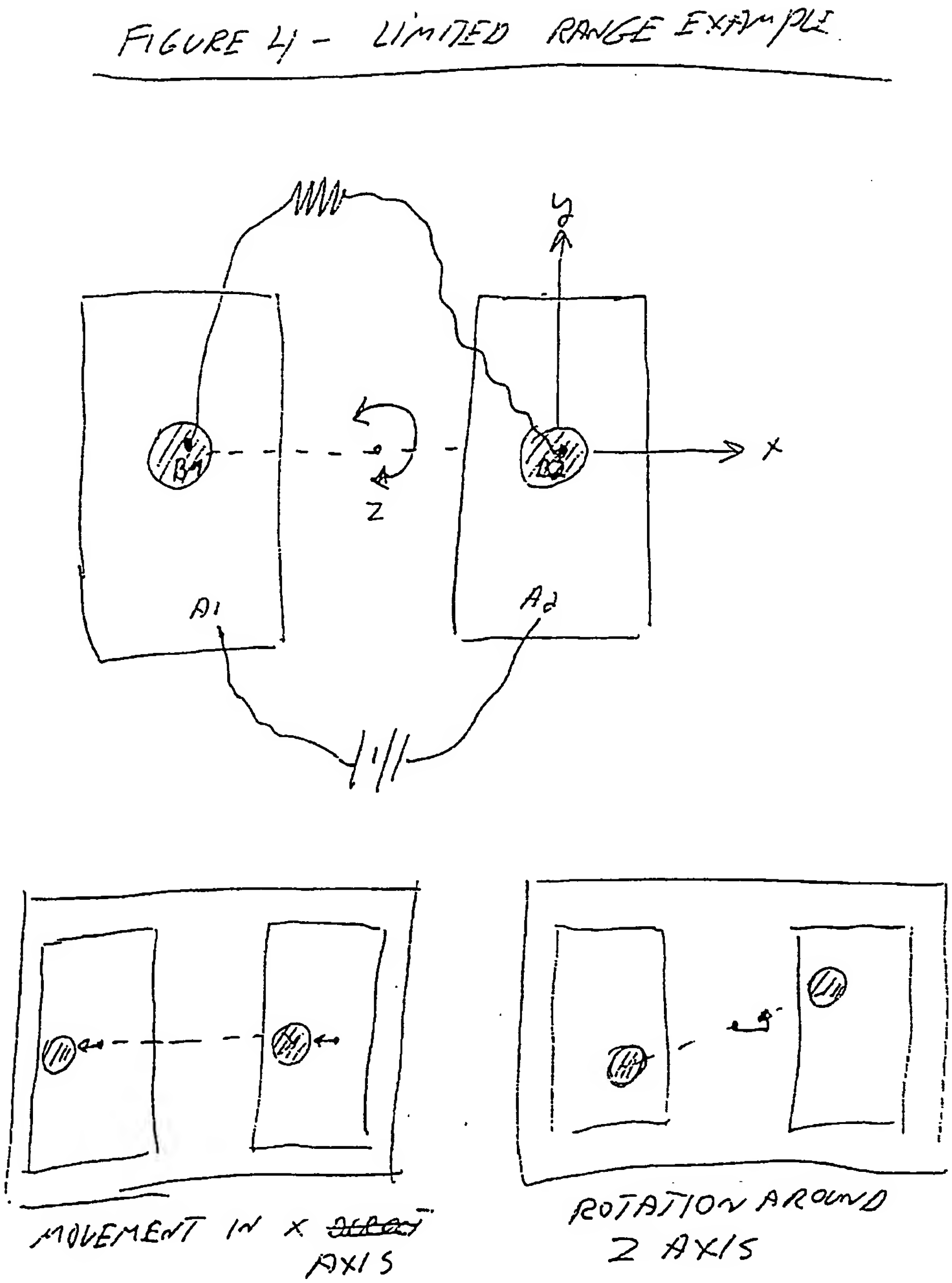


FIGURE 4 - LIMITED RANGE EXAMPLE
y
x
z
A1
A2
MOVEMENT IN X ~~DIRECT~~ AXIS
ROTATION AROUND Z AXIS

DRAWINGS:

Figure 5:

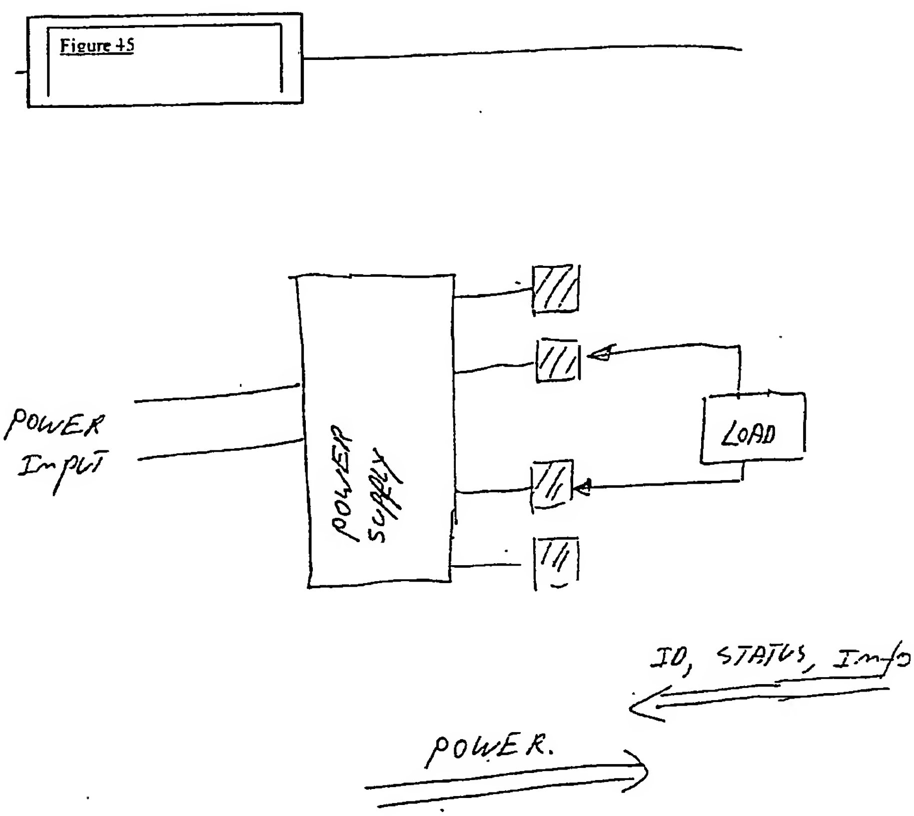


Figure 6:

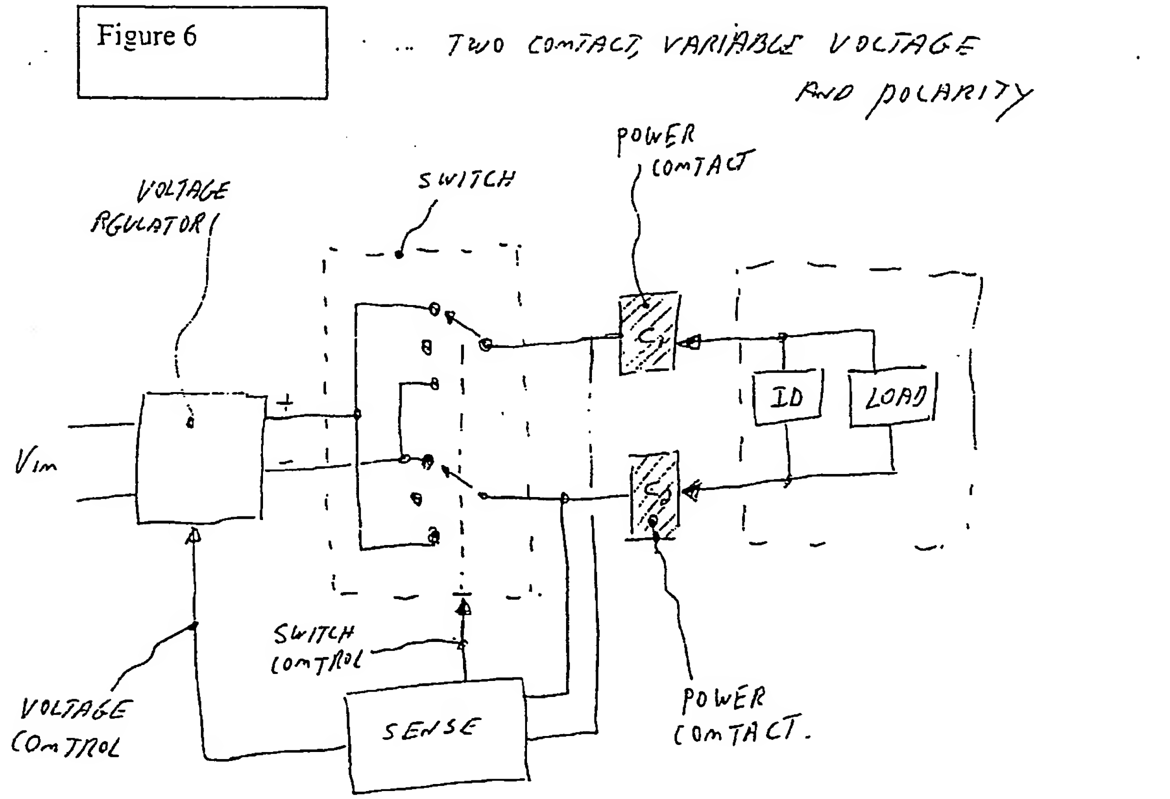


Figure 6
TWO CONTACT, VARIABLE VOLTAGE AND POLARITY
POWER CONTACT
SWITCH
VOLTAGE REGULATOR
V_{in}
+
-
C_1
C_2
ID
LOAD
SWITCH CONTROL
VOLTAGE CONTROL
SENSE
POWER CONTACT.

Figure 7:

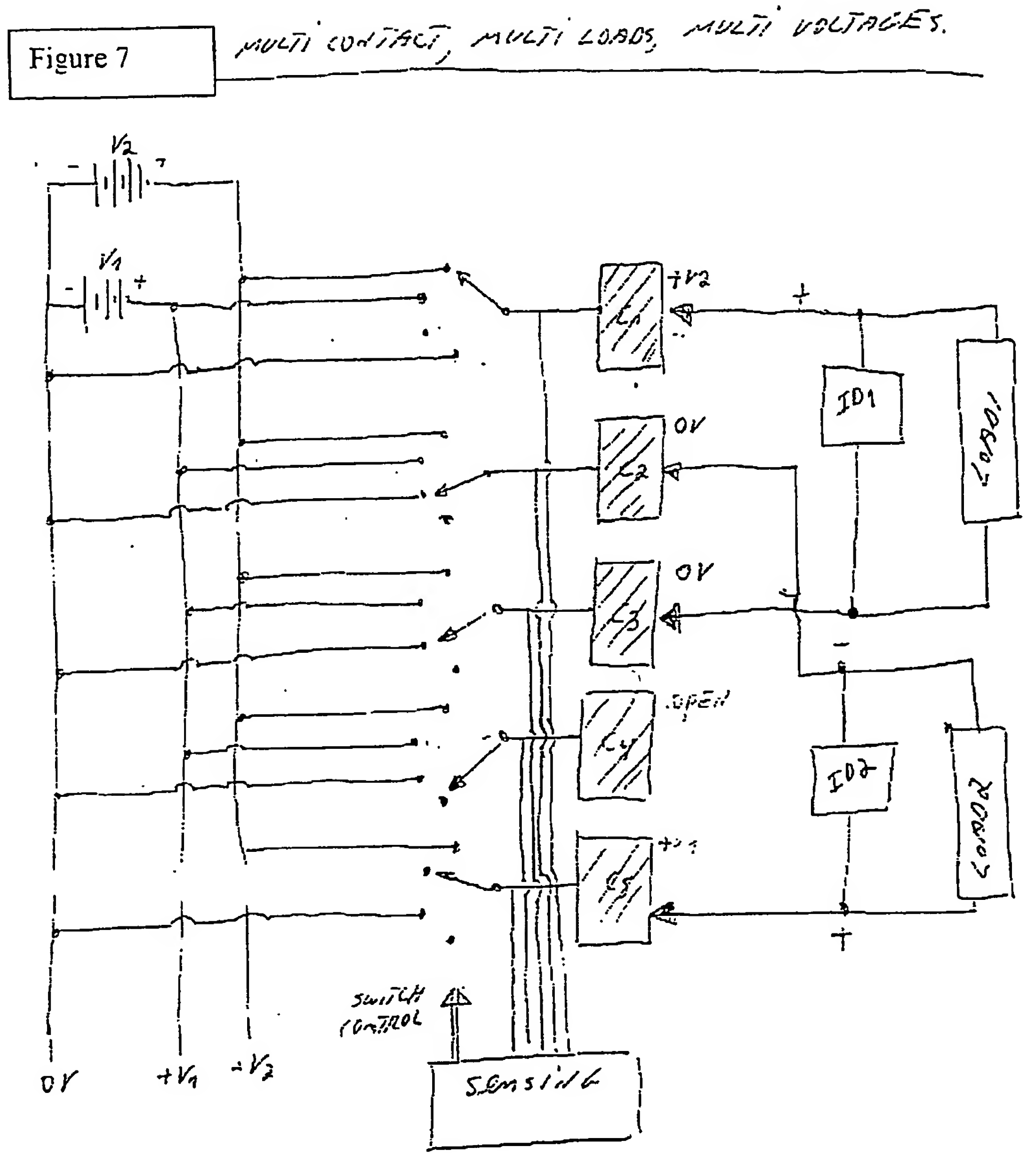


Figure 7
MULTI CONTACT, MULTI LOADS, MULTI VOLTAGES.
V2
V1
+V2
OV
OV
OPEN
ID1
ID2
LOAD1
LOAD2
SWITCH CONTROL
SENSING
OV
+V1
+V2

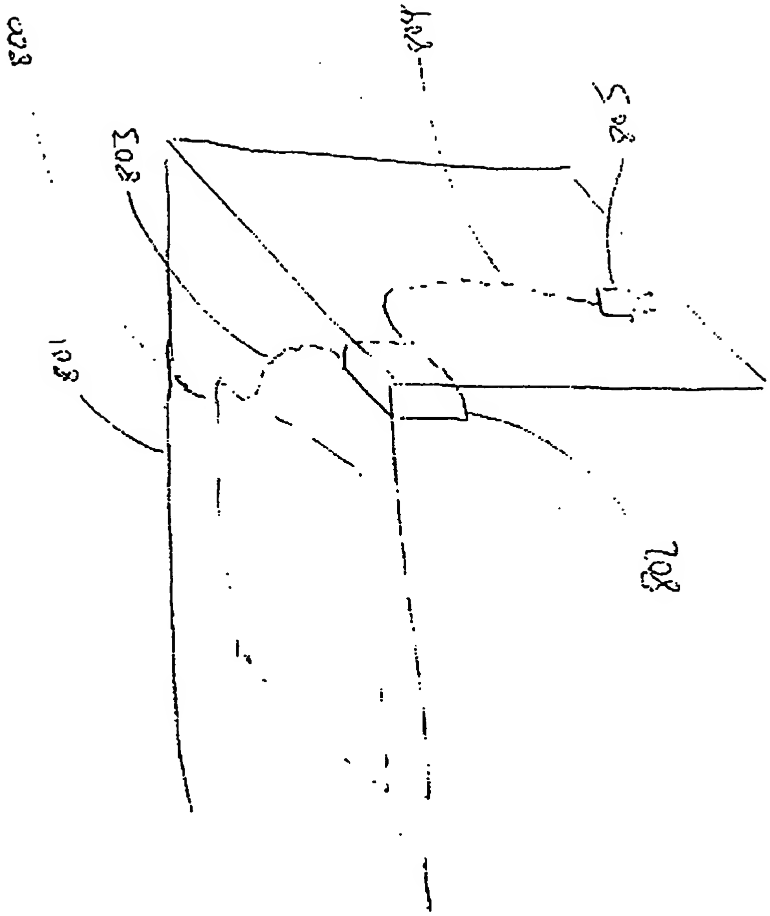


Fig. 8

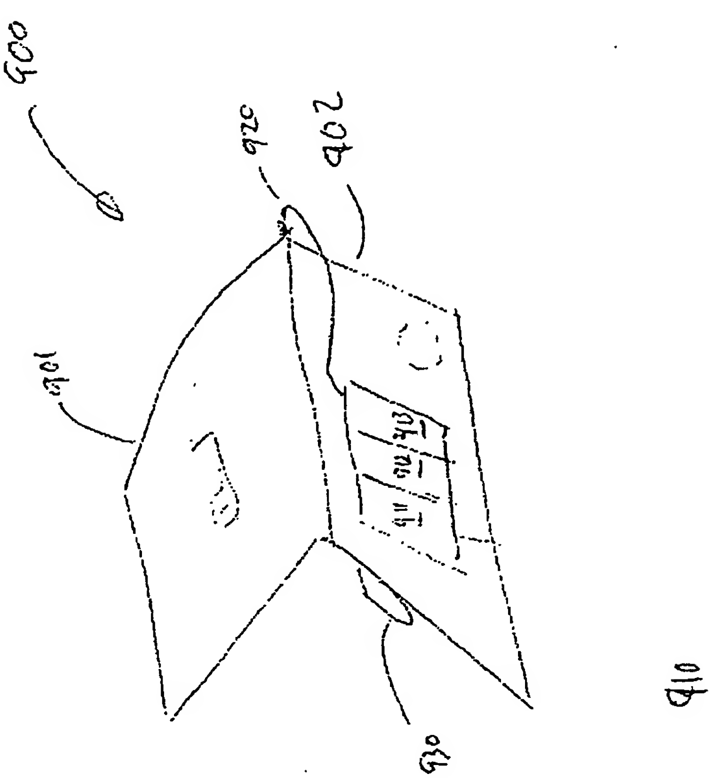


Fig. 9

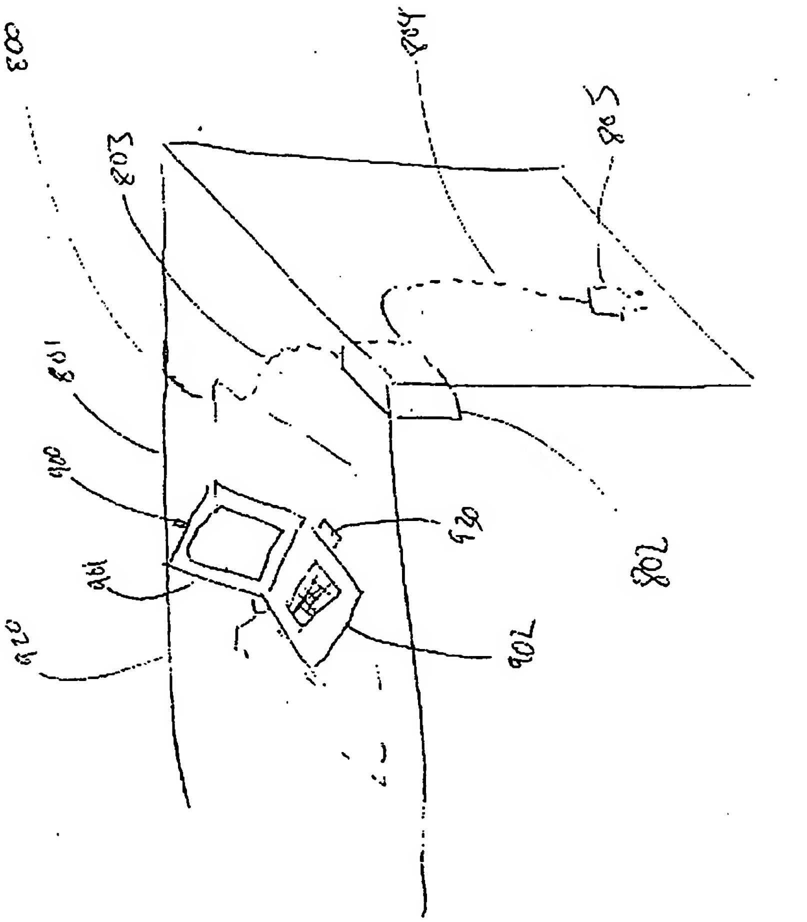


Fig. 10

DRAWINGS:

Figure 1:

FIGURE 1 THE THREE LEVELS OF FREEDOM

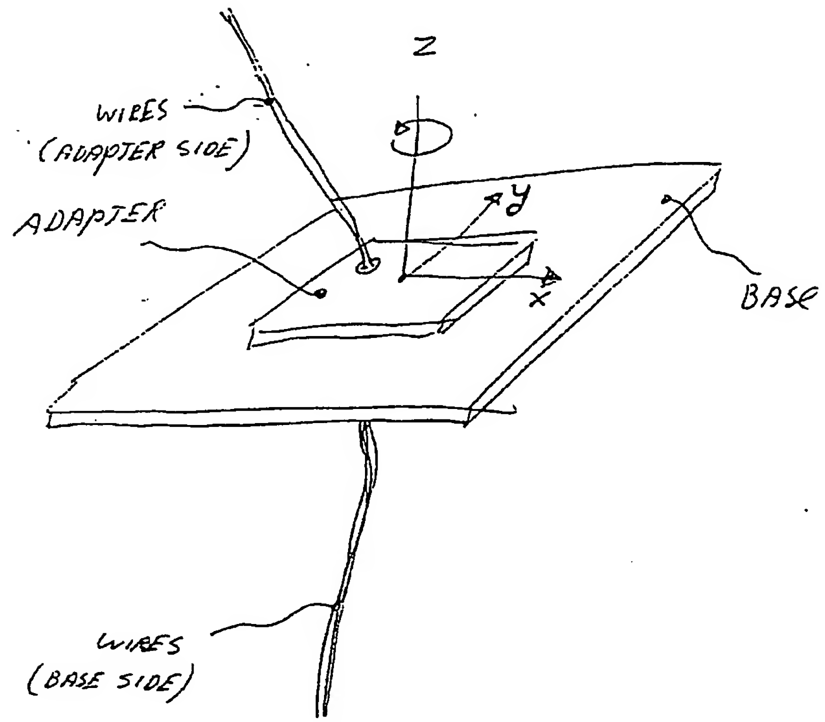


Figure 2:

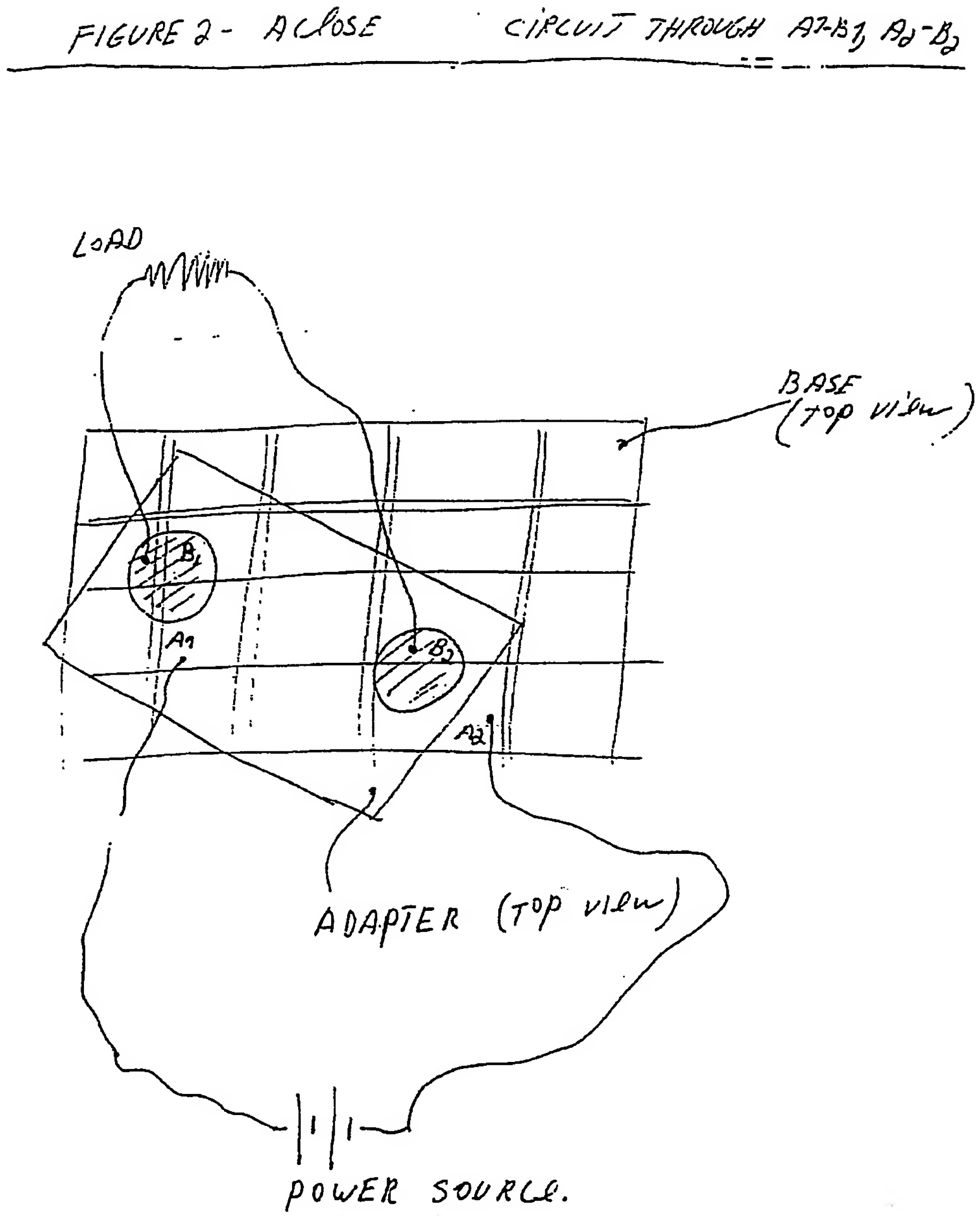


FIGURE 2 - A Close CIRCUIT THROUGH A1-B1, A2-B2
LOAD
BASE (TOP view)
B1
A1
B2
A2
ADAPTER (TOP view)
POWER SOURCE.

'igure 3:

FIGURE 3 - EXAMPLE 1.

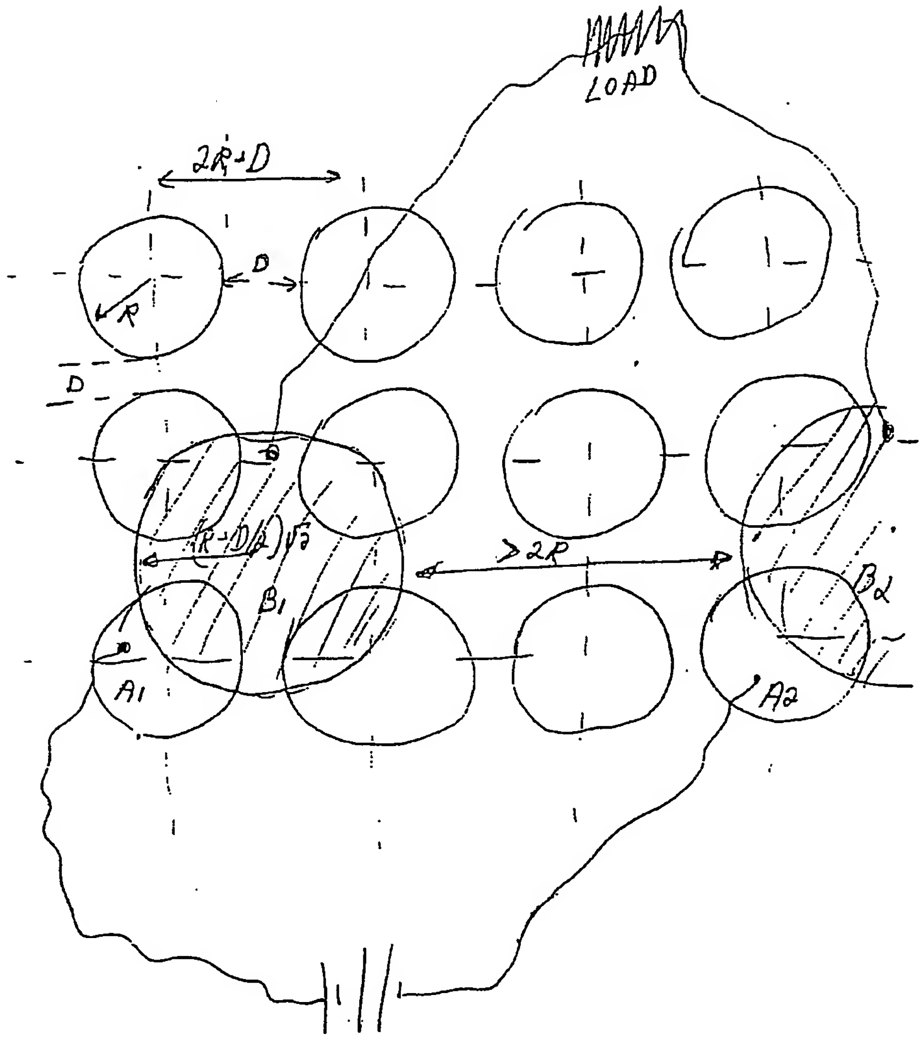
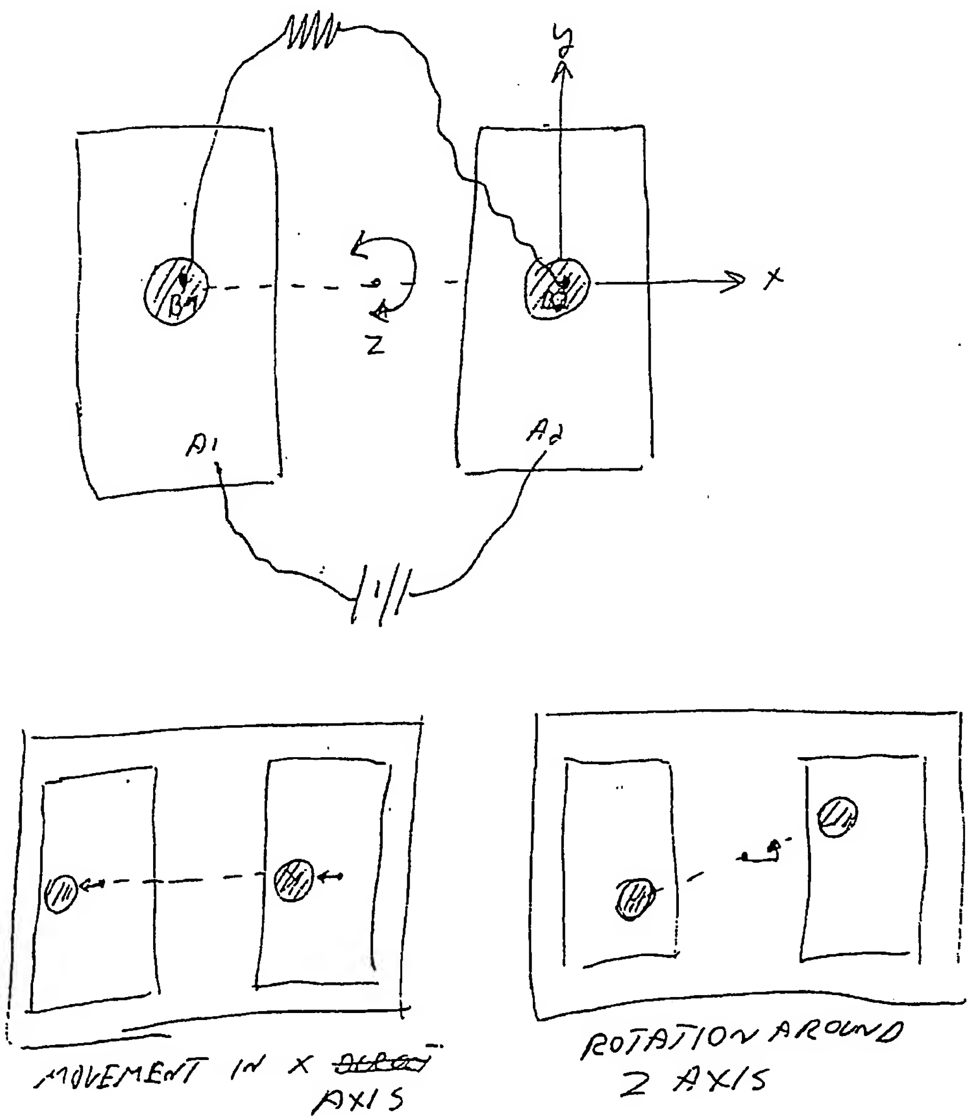


Figure 4:

FIGURE 4 - LIMITED RANGE EXAMPLE



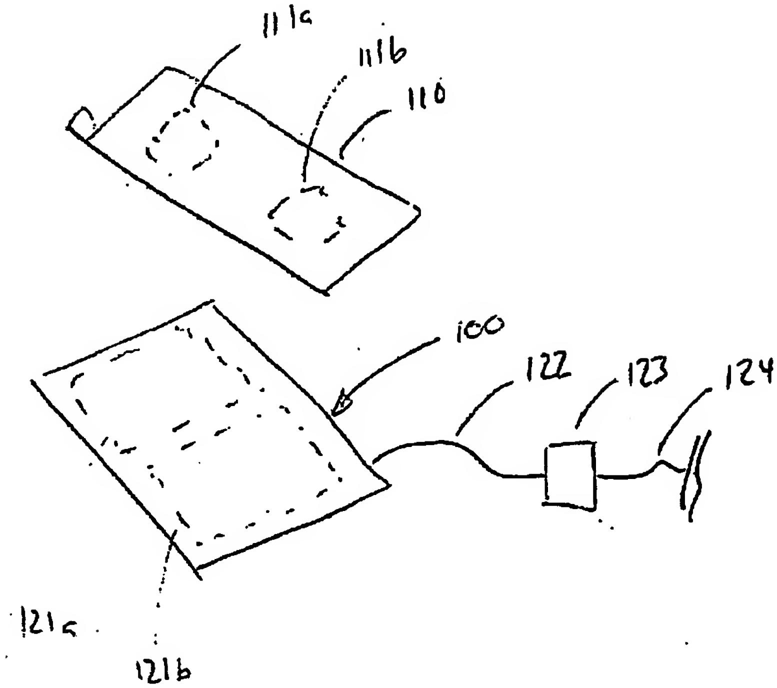


Fig. 1

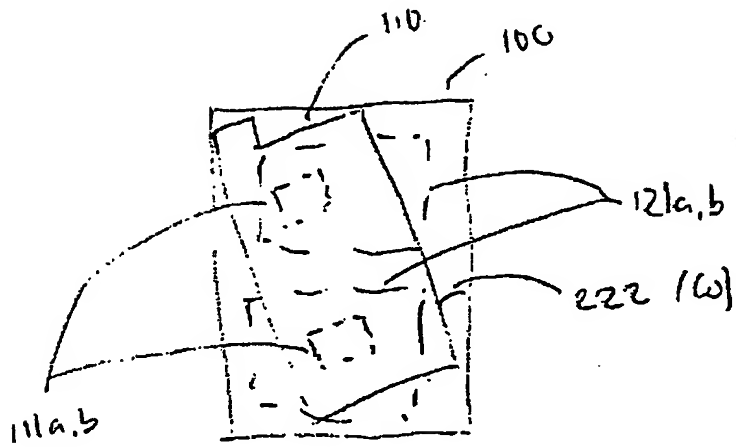


Fig. 2.

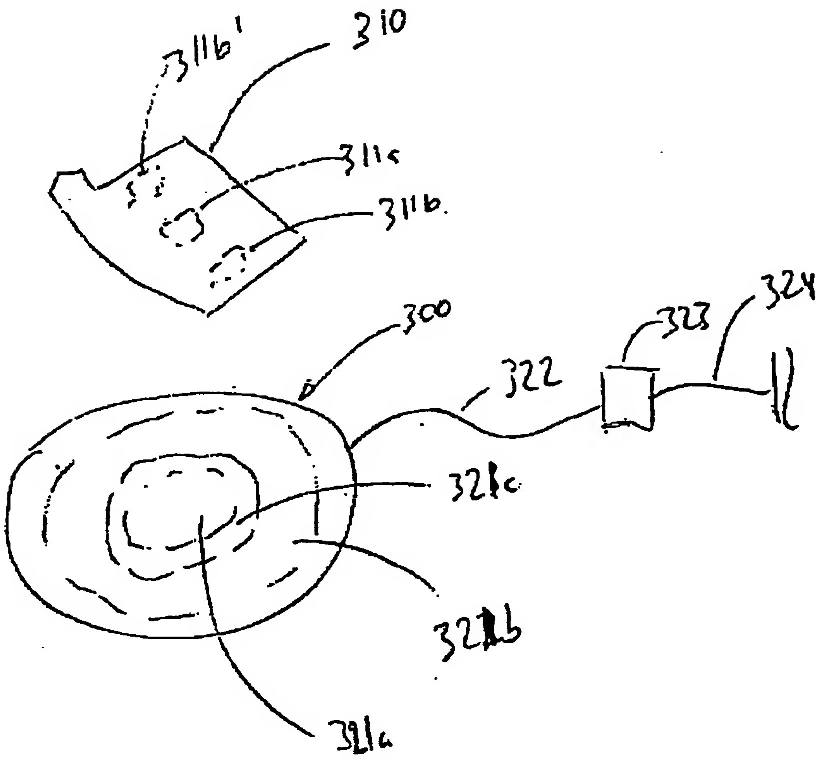


Fig. 3

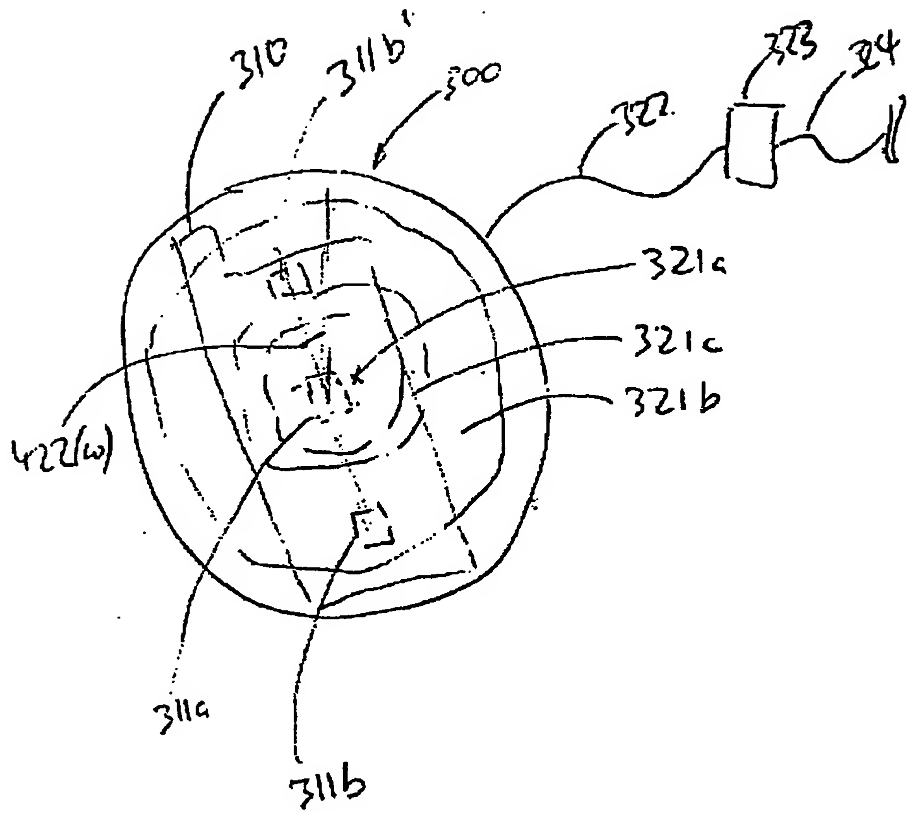


Fig 4.

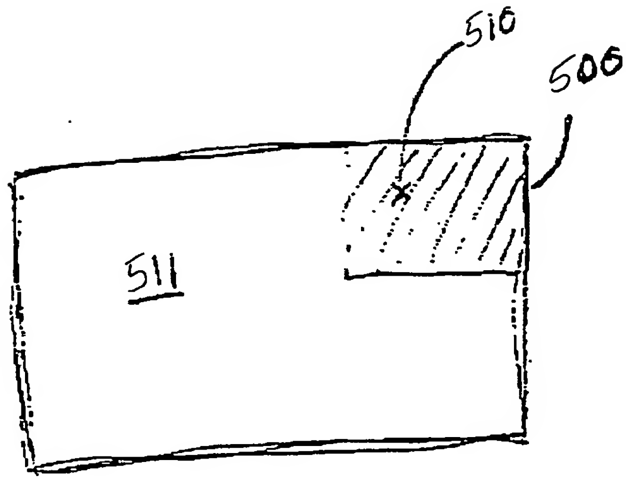


Fig. 5

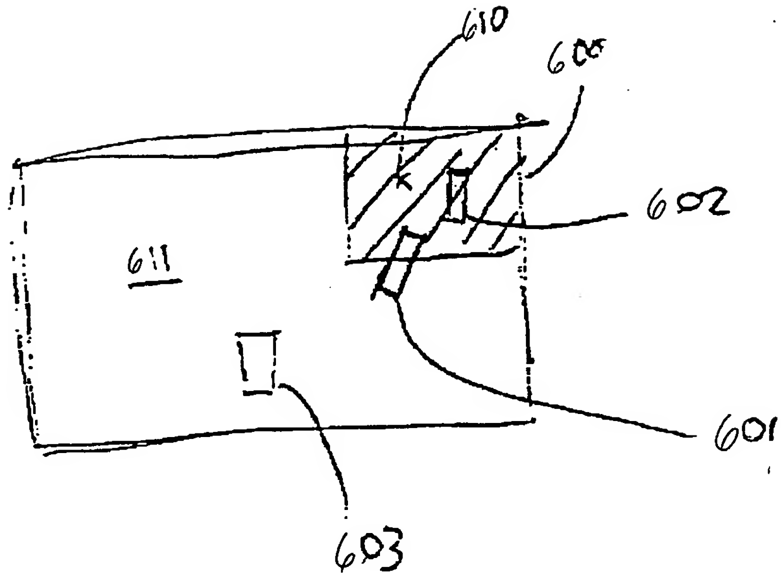


Fig. 6

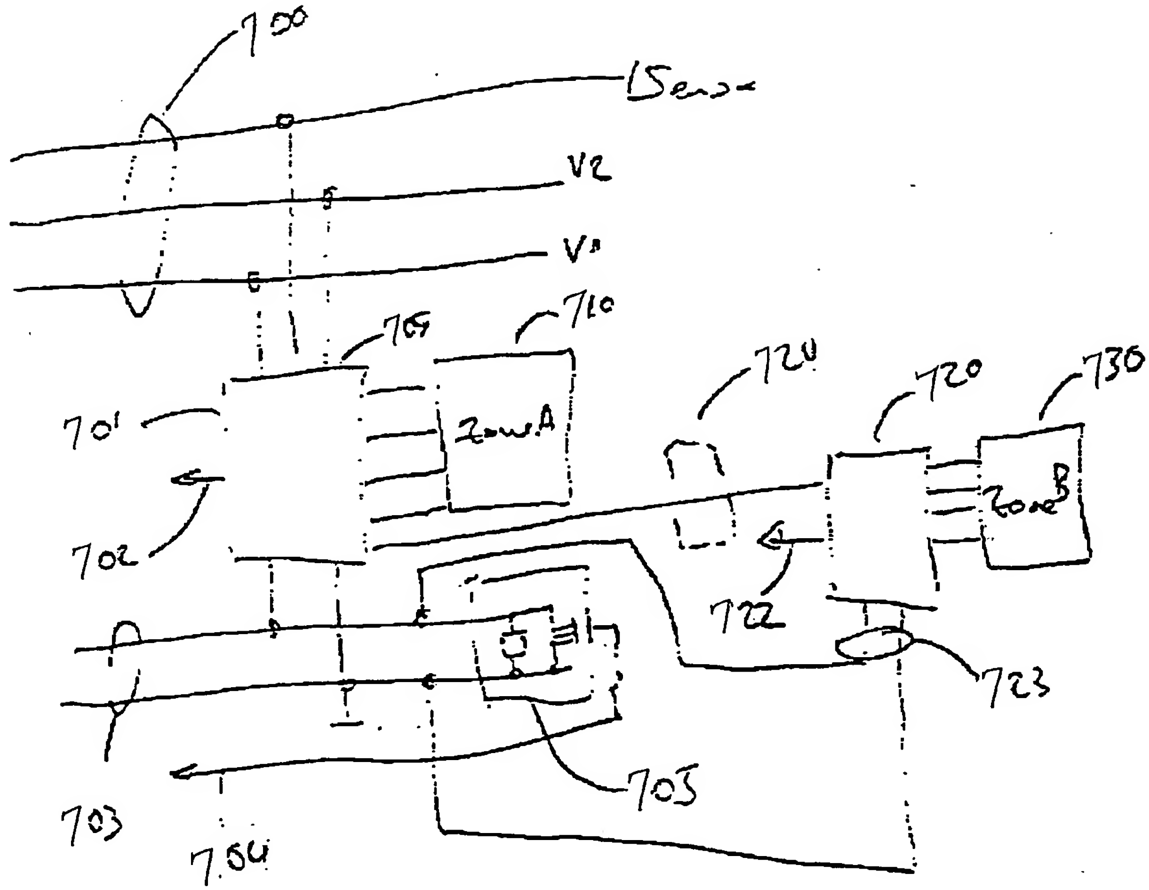

700
ISense
V2
V1
705
710
Zone A
701
702
720
720
730
Zone B
722
723
703
705
704

Fig. 7

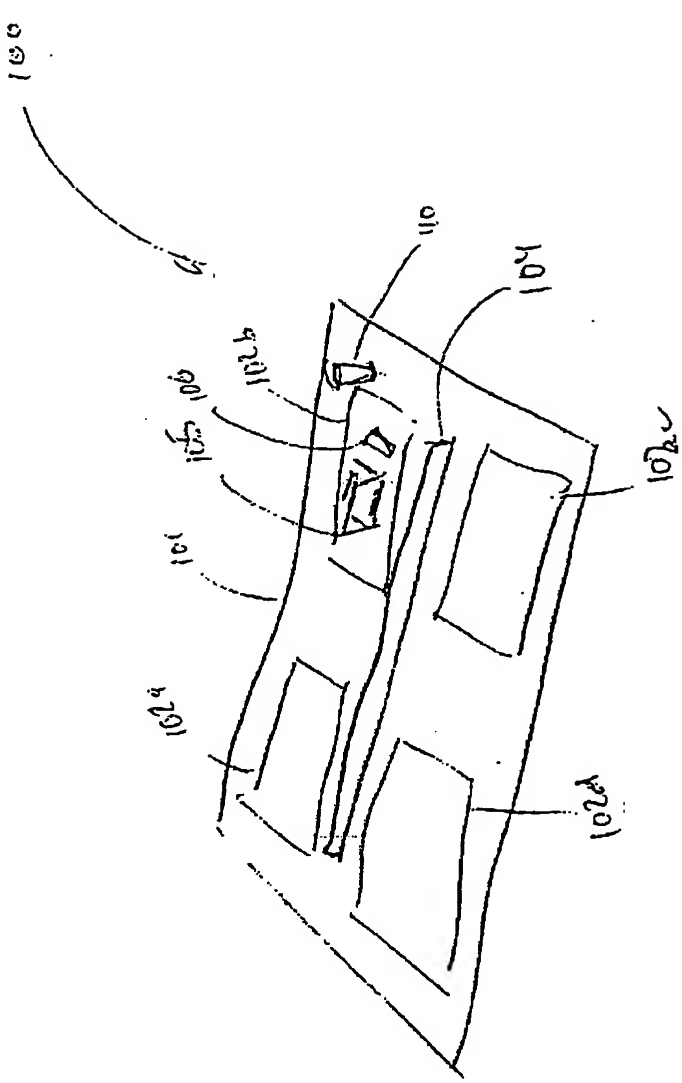


Fig. 1

MOW7

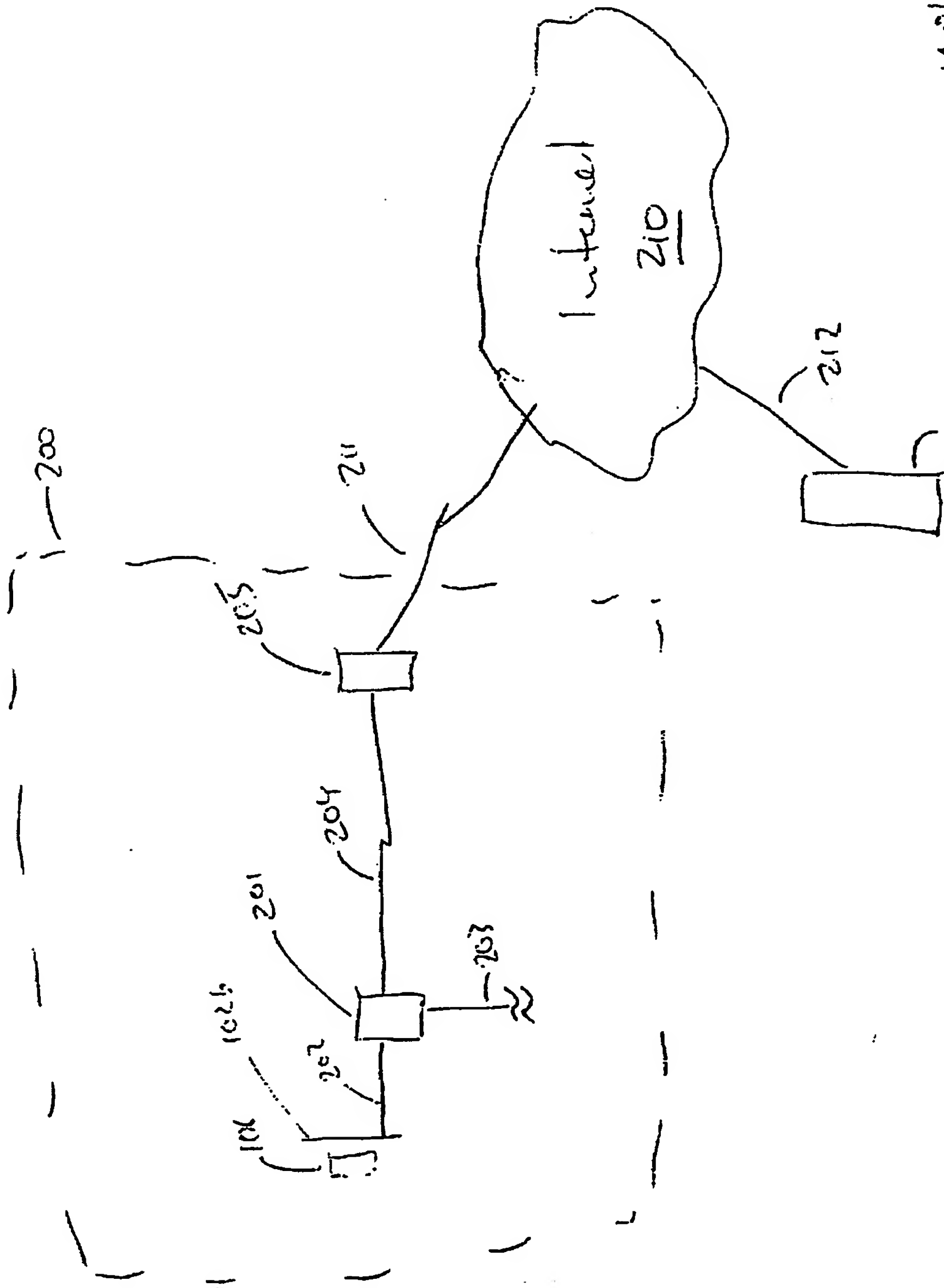


Fig 2

HOW7

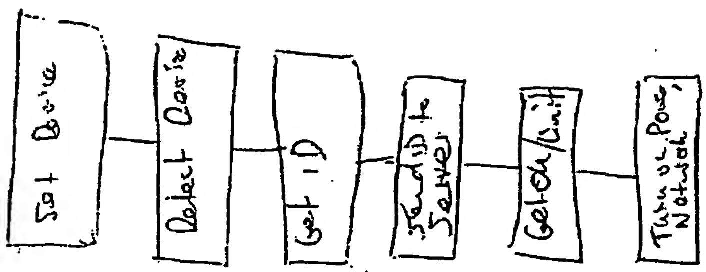


Fig 3